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POLSIM

A MICRO-SIMULATION MODEL FOR POLICY ANALYSIS

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1. Introduction

The public sector affects both the level and distribution of national income. Until fairly recently concern has been focused largely on questions of the level. This has been reflected in Canada in the development of a number of aggregate economic models which have tended to concentrate on the business sector. Perhaps the best known of these are RDX2 and CANDIDE. Although these models do provide treatment of both the household and government sectors, the manner in which this is done does not lend them to the study of the income distributional consequences of government programs. This is the case because the distribution of income is most meaningfully considered in relation to individual households or families, the recipients of national income, and these models do not maintain sufficient household or family detail. It is clear that any exercise designed to elucidate distributional issues must begin with the household sector portrayed in great particularity, preferably at the level of the individual person.

Of course, given the availability of elaborate sets of microdata, it is possible to develop fairly simple models that enable one to pose "what if" questions for some past period. But this kind of static analysis, although useful, does not allow one to come to grips with a host of questions bearing on income distributional issues which are crucially dependent on time. To be

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relevant, it is also necessary to have the ability to forecast the workings of a large number of factors, economic and demographic, that bear on the household sector and determine the distribution of income.

It is also necessary to have the capacity to model government programs as comprehensively as possible, and in considerable structural detail. It is not possible to know what any single program will do if we are unable to situate that program in the context of an environment produced, in part, by a number of other programs. Further, it is not enough to model the general direction of the effects produced by a given program as a whole. We are concerned to understand the significance of particular program designs. To do this we require the ability to test the effect caused by an alteration of internal program components.

The term simulation is usually used to describe techniques related to the construction of models or simulators whose operations are intended to resemble the behaviour of actual or potential operating systems. Microdata simulation involves the construction of simulators intended to function in the same manner as operating systems comprised of a large number of basic components or decision units. In carrying out this form of simulation one may employ the technique of endowing microcomponents with behavioural functions and of deriving the consequences (in terms of individual

behaviour) of different environments (specified by a set of independent variables) on the microcomponents. Or, one may employ the technique of stochastic events. In this case microcomponents are not endowed with explicit specifications as to their behaviour under differing environments but rather are thought to behave as particles governed by specified laws of chance. That is, the causal relationships that actually determine behaviour are considered only implicitly, either because they are too complex to be modelled, or because insufficient data exists to estimate the specified model. One is only able to observe that the micro-components reside in a certain "state" for a period of time and then move to other "states". The precise laws governing individual movement are unknown. What is known is that if a large number of "state" changes or movements are observed, the behaviour in question can be described as if it depended solely on chance.

The probabilistic analog of a deterministic causal process is the first order Markov-chain. In this kind of process, the future state of the world is completely independent of time periods preceding the present. In the present context, then, micro-component behaviour would be described completely by its present state, and the Markov-chain probabilities that relate the present to the future. In the broadest possible terms this is the POLSIM Model: it is a Markov-chain simulation of individual demographic, labour force, and market income behaviour.

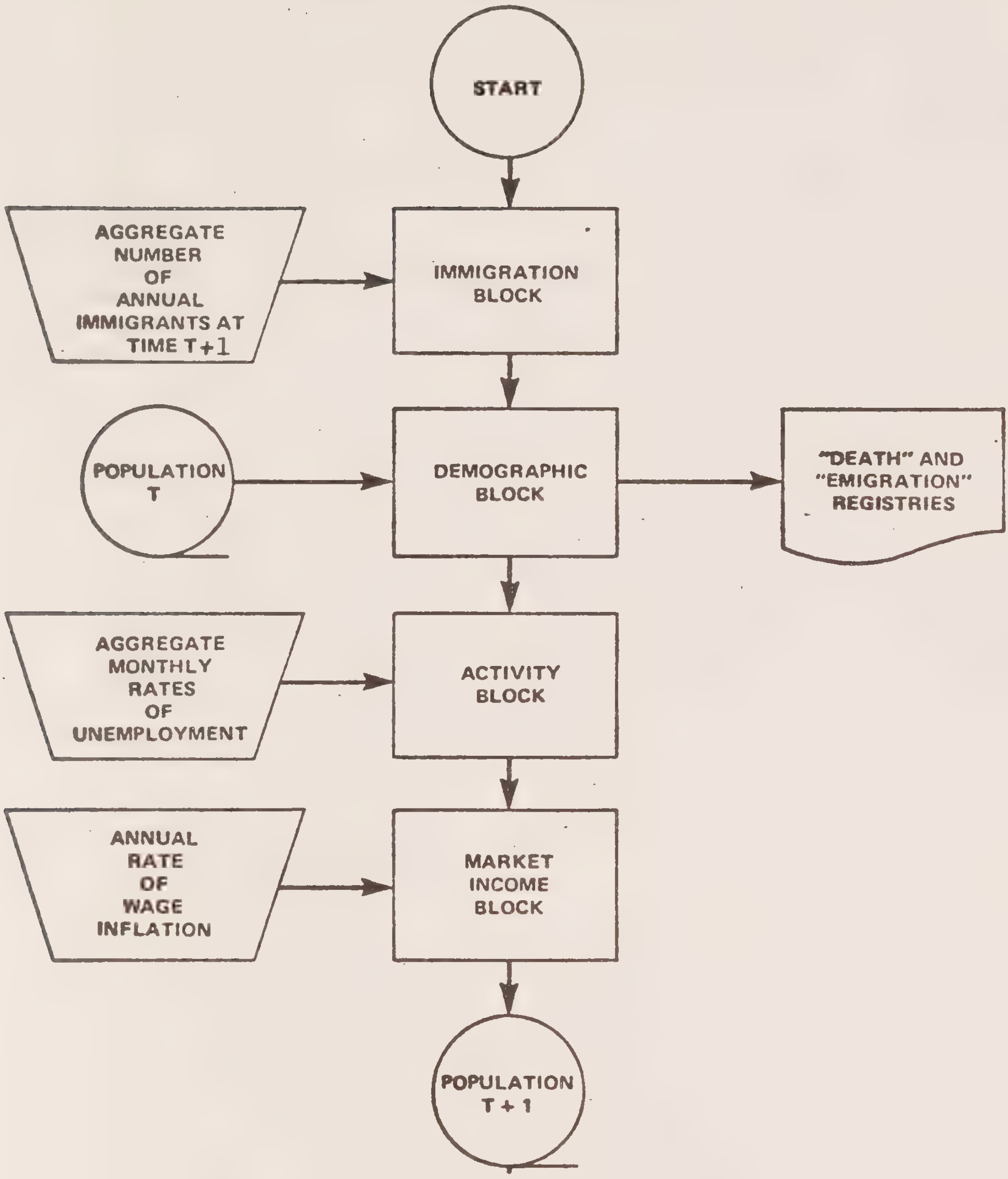
More specifically, POLSIM is an annual microdata model of the Canadian household sector. The basic component of the model is the individual person. Individual persons may be associated into nuclear family units in the model but the prime focus is always maintained on the individual. The model receives, as exogenous input, a specification of the native Canadian population for some year. This specification is made in terms of a number of characteristics (a state vector) for every individual in the initial population.

The individual state vector is comprised of three different sets of characteristics: demographic (e.g., age, sex, etc.), activity (e.g., weeks employed, weeks unemployed, etc.) and income (e.g., annual wages, annual dividend income, etc.). Most of these characteristics change over time. The function of the model is to effect these changes in the light of the individual's particular circumstances, as portrayed by his state vector immediately before the change, and conditions prevailing in the socio-economic environment.

The POLSIM model is constructed as a number of connected blocks: (i) immigration, (ii) demographic (iii) activity status, and (iv) market income. Each of these blocks contains a series of processes or transformations which operate on individual state vectors to produce annual change. The structure of the

Figure 1

THE POLSIM MODEL



model is given in Figure 1. The model begins with a description of the population at some year t, and then proceeds to synthesize a new population representative of the year t+1. This updated population can then become input to a second run of the model, and so on, until the initial population has been updated as many years as required. This final population (as well as any intermediate population) can then be used to simulate the absolute and distributional consequences of a given government program.

The next section of this paper will describe the individual state vector and the base year population in more detail, while the third section will elaborate on the model structure. Section 4 will then outline some simulation results.

2. The POLSIM Data Base

The data base for the POLSIM model is obtained from the Statistics Canada Survey of Consumer Finance. In the recent past this Survey has been conducted every two years. In future, it will be taken annually, but every second survey will be of small scale and of a specialized nature so as to make it unsuitable for initial year model population specification. For the present purpose, therefore, we may only regard each second survey as useful.

The SCF is at present the most extensive micro-data base available in Canada, with the exception of the census. Coverage extends to all of the population of Canada with the exception of (i) persons resident in the territories, (ii) persons resident on Indian reservations, and (iii) persons resident in institutions (e.g., prisons, mental hospitals, etc.). The Survey carries a wide variety of income and other information capable of organization on either an economic or census family basis. The quality of this data is generally very high and its availability (for our present purpose) every two years makes it timely.

In the last section we described in very broad terms the nature of the individual state vector, that is, the fact that it contains demographic, activity and income characteristics. The complete vector in its most detailed form contains 23 characteristics in all. These characteristics are derived from the individual SCF records and are listed below.

1. Previous Year Family Unit
2. Family Unit Identifier
3. Province
4. Size of Family
5. Census Family Relationship
6. Marital Status
7. Age
8. Sex
9. Major Source of Income
10. Weeks in School
11. Weeks employed
12. Weeks unemployed
13. Weeks in the non-labour force
14. Education
15. April Activity Status
16. Weight
17. Employment Category
18. Employment Income
19. Interest and Other Investment Income
20. Dividends
21. Retirement Pension, Superannuation, and Annuities
22. Other Money Income
23. Total Income

These 23 characteristics taken together "describe" one individual. The entire Canadian population could in principle be "described" in the context of the model by a large number of individual state vectors - one for each individual in the population. This would, however, be a very inefficient procedure. A much more economical means of accounting for the entire population is by way of a representative sample. In this case, each individual state vector in the model stands for or represents a larger number of "identical" persons in the real population.

The model requires, as initial input, a weighted sample of individual state vectors which describe the population of Canada for some year. At the present time we have been working with two such base years, 1967 and 1971. The Survey of Consumer Finance undertakes its geographically stratified sampling of Canadian households in April of the year following the survey year (e.g., April 1968 for 1967 or April 1972 for 1971). The sample included 37,985 individuals over fourteen years of age and in receipt of cash income in 1967 and 43,039 individuals aged fourteen years or more who were in receipt of cash income in 1971. Over time, of course, as more current data becomes available, initial year state descriptions for more recent periods can be constructed. It is important to be able to continually update the initial year as a guard against the generation of inaccurate projections.

Individual state vectors are weighted by the Survey of Consumer Finance in order to calculate population estimates. These weights are unequal, running from 30 up to 3,000 in increments of 10. In order to conform to the logic of POLSIM, individual state vectors must possess equal weights. It was therefore necessary to adjust the SCF samples in such a way as to produce equally weighted records. We adopted a common weight of 50 (i.e. one individual in the sample represents 50 in the real population). The adjustment was then done by an unbiased rounding procedure (rounding to multiples of 50) combined with record replication.

The process of replicating sample state vectors increases the number of sample individuals from 79,479 to 397,960 in 1967 and from 79,528 to 425,864 in 1971.

3. The Model Structure

As mentioned previously, the POLSIM model is divided into 4 blocks: Immigration, Demographic, Activity, and Market Income. The purpose of the Immigration Block is to fabricate the state vectors of the immigrant population that will arrive in Canada during the year being simulated. The purpose of the other three blocks is to update respective subsets of the individual state vector. This section will briefly describe these four blocks, outlining their functions and the way in which they operate. The reader is referred to the Appendix for the detailed flow chart of each block.

The Immigration Block

The objective of the immigration block is to increment the base population in a given year by the total number of immigrants that will arrive in that year. This entails two distinct problems: the projection of the total number of immigrants who are to arrive in the given year, and the synthesis of individual state vectors for each of these individuals. The present version of the model does not attempt to determine projections of the total number of immigrants. Such projections are simply assumed by the model to be exogenously determined. The immigration block is therefore concerned principally with the construction of individual state vectors for a pre-determined number of people.

The immigration block operates as follows. The first step is to calculate the total number of people in each of 240 age-sex-marital status-province classes. These classes, consist only of adults. The numbers of children in given classes are determined after married couples are formed. The number of adults in a given class is the product of the total number of immigrants arriving and the probability of being in a given class, divided by the weighting factor of 50.

The model then calculates the individual state vectors on a province by province basis. State vectors are determined for all the people in a given province, and these are then written out on tape. Those for single males are calculated first. The procedure is to consider one individual at a time, calculating his entire state vector from various probability distributions. The next individual is then considered, and so on, until all single males have been dealt with. An analogous procedure is then repeated for all single females, and finally for all members of families. The family loop includes the calculation of the number of children a given family will have, as well as these children's respective state vectors.

Once all the immigrants in a given province have been created, their state vectors are written out, and the calculations are repeated for the next province. The final output from the immigration block consists of state vectors describing all of the immigrants in each of the ten provinces. These state vectors are now ready to enter the demographic block along with the remainder (i.e. non-immigrant portion) of the population.

The Demographic Block

The purpose of the Demographic block is to update the demographic variables of the individual state vector. These variables are the individual's province of residence,

his family size, his dependency status (whether he is a family head, a wife, or a dependent child), his marital status, and his age. The Demographic Block also determines whether or not a family will emigrate. Since the basic time unit of the POLSIM model is one year, the updating of these state variables is on an annual basis.

There are three features to the Demographic Block that distinguish it from the other three blocks in POLSIM. The first is that it eliminates and creates individual records. New records are created in the Demographic Block through the simulation of births, while others are eliminated through the processes of death and emigration. The second distinctive thing about the Demographic Block is that it proceeds in two distinct phases. The Activity and Market Income blocks are somewhat simpler in this respect. They require only a single sequential processing of all individual records. Two phases are necessary in the Demographic Block because of the need to simulate marriage. Since individuals in the base year population must marry other individuals in the same population, it is necessary to first determine all of the "marriageable" individuals. Only then can these individuals be paired. The final distinctive feature of the Demographic Block is that if deals with family records, whereas the other two processing blocks work with individuals only. The reason for this is that demographic variables are inherently familiy variables; that is, dependency status, family size etc., can clearly only be determined within the context of a whole family.

The Demographic Block consists of two distinct phases. The input to the first phase is the file containing the native Canadian population of the previous year together with the population of new immigrants for the current year. The first phase of the block then produces three output files. The first output file contains the records of all individuals who either emigrate or die during the year being simulated (i.e., the emigration and death registries). The second output file contains the records of all individuals who have been determined to be eligible for marriage during the simulation year. This file, called the "Marriage Pool", will be used in the second phase of the Demographic Block. The third output file contains the output records of all remaining individuals (all those who have not died, emigrated, or been deemed ready for marriage). In phase one of the Demographic Block, then, all individuals who have not died or emigrated will have had all their demographic variables completely updated. Persons who will marry, on the other hand, are updated in all respects except for "pairing" and their province of residence.

The second phase is exclusively concerned with persons in the marriage pool and determines "who will marry whom". The individuals who have previously been recorded in the marriage pool (i.e., the second file mentioned above) are formed into couples on the basis of age, province of residence and education. The demographic

characteristics of these couples, with the exception of province of residence, have all been updated in phase one, and phase two now determines the province of residence of the new couples, in the same manner as is true of persons who are not marrying between t and t+1. All the couples in this "Marriage Pool" file are then merged with the records in the third output file (i.e., individuals who do not die, emigrate or marry during the simulation period) of phase one.

The basic method by which the stochastic decisions pertinent to the updating of the state vectors are made is Monte Carlo simulation. The first decision to be made after a family record has been read is that of whether or not the individuals in the family will survive. Survival is assumed to be an individual matter. All individuals within the given family are processed one by one. If the Monte Carlo procedure determines that the person shall die, he is recorded on the death registry, and his record is not considered further. If nobody in the family survives, another family record is read from the Initial Year file. Surviving individuals proceed to the birth process.

Births may be legitimate or illegitimate. If the woman is married, and it is determined that she will have a child, the child is simply added to the given family unit. If, however, she is not married and she is not the head of a family unit, she and her baby are assumed to form a new family unit; and, of course, she becomes the head of this new unit.

The divorce process is now commenced for all families containing both a head and a spouse. If divorce is determined to occur, the family is split in two. All children are assumed to go with the mother into a new, separate family unit with the mother as head.

All non-married individuals, excluding those who have become divorced in the current simulation, are now tested to determined whether they will get married. If this event occurs, the person is declared to be the head of a new family unit.

All individuals in each of the original families who are dependent (i.e., neither heads nor wives) are now tested to see whether they will leave home or not. If this event occurs, the individual is declared to be the head of a new family consisting of himself alone. It is clear that each of the original family units might generate a whole set of new family units through marriage of dependents, divorce, birth of an illegitimate child, or as a consequence of a dependent leaving home.

For all families it is necessary to determine whether or not they will emigrate. This is considered to be a family decision, rather than an individual decision. All families that do emigrate are recorded on the emigration registry, and are not considered further.

Those family units that do not emigrate, with the exception of those who are going to be married in the current simulation, are now processed to determine their new province of residence. As mentioned above, province of residence of newly married couples is determined in phase two, after marriage has taken place.

The final step of the first phase is to record all family units on the proper files. Those families whose head is to be married are recorded on the marriage pool tape (file #2), while all others are recorded on file #3. (It will be recalled that file #1 contains the death and emigration registries). At this stage file #3 contains all remaining families, with the exception of new families formed through marriage. All demographic variables of the individuals on the third file have been completely updated.

In the second phase of the Demographic Block the individuals who are to be married are processed to form couples. Once this is completed, all the new husbands and wives, together with any dependents they might have, are formed into family units. The province of residence of these families of file #3 is then stochastically determined to create the completely updated initial year file. This is the final product of the Demographic Block, which now becomes input to the Activity Block that follows.

<u>The Activity Block</u>

Broadly speaking, the purpose of the Activity Status Block is twofold: first, to update those variables in the individual state vector that describe what a person is "doing" during the year being simulated; and, second, to make certain adjustments to the individual state vector preparatory to updating the person's income in the Market Income Block. Specifically, the Activity Block does the following:

(a) it determines the number of weeks during the year being simulated that the person spends in school, employed, unemployed, and in the non-labour force (where "non-labour force" is defined so as to exclude those in school);

(b) it determines whether a person advances his education;

(c) it determines the person's activity at the end of the year being simulated or the beginning of the next simulation year (the "year" being simulated is defined as April through March);

(d) it makes any necessary changes in a person's employment category;

(e) and finally, it converts a person's annual wages to a weekly wage rate if he was employed as a Class B person in the year preceeding the one being simulated.

(A "Class B" person is one who is subject to unemployment). The Activity Block makes the requisite changes in the individual's state vector on the basis of his present year's demographic characteristics, his past year's activities, and exogenously determined monthly Canadian aggregate rates of unemployment.

The methodological approach taken by the Activity Block is somewhat different than that taken by the other blocks in POLSIM. In the Market Income Block, for example, the various components of an individual's income are simulated directly. A transition matrix determines to what extent, if any, a particular component of a person's income is to be increased or decreased during the simulated year. In the Activity Block such direct transitions are not possible. Instead, a person is thought of as being in one of four activity states: employment, unemployment, non-labour force, or school. Transitions among these four states then take place <u>month by month</u>, tracing out a year long "activity history" for a given individual. The number of weeks in each of the four states, any change in education status, and any changes in employment category are then inferred from this history.

Much of the Activity Block is concerned with the problem of calculating the transition matrices that are used to determine how a person will move from month to month. That is, these matrices are not read in as data, but rather are calculated from other data in the model.

A general picture of the Activity Block can be obtained from the Macro Flow Chart given in the Appendix. The block begins by reading in all of the input parameters. These parameters include regression coefficients and unemployment rates from which an initial set of transition matrices is calculated, parameters that are used to adjust these probabilities in various ways, and probabilities used to determine whether and how a person advances through school. Once all of the parameters are properly constructed, individuals are passed through the logic of the simulation model proper. In this section persons are directed through various processes, depending on how they relate to the labour force (their Employment Category*), and a few other factors. Children, for example, bypass most of the Activity processes completely. And persons who are assumed to never become unemployed bypass the monthly labour force simulation. The relevant state variables are then updated, and the whole procedure is repeated for the next individual.

The idea behind the whole Activity Block procedure is to infer what an individual does during a <u>year</u> by examining what he does in every <u>month</u> of that year. A year is assumed to run from April through April (thus providing a starting point for the next year's simulation).

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* The employment category indicates whether this is an individual's first year in employment; whether he is retired and if it is his first year of retirement; whether he is in the labour force or not; and if he is in the labour force whether he will receive a private pension on retirement, and whether he will be subject to unemployment.

An individual thus starts out in April doing something (being in a particular education state, being employed, etc.) and this then influences (together with the exogenously inputted influence of aggregate unemployment) what he will be doing in May, and so on. The whole year is traced out in this way. An individual moves from state to state, depending on his present state, his age, the month being considered, and other factors. Once the entire year has been completed, the year itself can be summarized in the relevant state variables.

The Market Income Block

The POLSIM model divides an individual's total annual income into four main components: employment income, property income, retirement income, and other money income. Employment income is income in the form of wages and salaries, military pay and allowances, and net income from farming, fishing, and other forms of self-employment. Property income is divided into two subcomponents: dividends and other investment income. Dividends are self-explanatory. Other investment income consists, generally, of income from fixed face value assets such as bonds, deposits, and savings certificates, and all other forms of investment income. Retirement income consists of private pensions, superannuation, and annuities. Other money income includes income from roomers and boarders, alimony, gifts, and income from any other source not mentioned above.

The purpose of the Market Income Block is to update these income variables, on an annual basis, as the person moves from year to year through the simulation. The main technique for doing this is again Monte Carlo Simulator. Broadly speaking, the updating process consists of two general problems. The first is to assign initial component incomes to a person if he is "eligible" and if the particular component being examined was zero in the previous year. (A "component" of income is one of the four sources mentioned above.) The second problem is to determine transitions on each of the income components that were not zero in the previous year. Both of these two kinds of processes are generally handled by either a deterministic function, a stochastic function, or a combination of these. The exact meaning of "eligibility" in the various cases, and the way in which the several transitions are effected, will now be discussed.

The Market Income block begins by reading and assembling all of the parameters that will be necessary to update an individual's income variables. All of the constant parameters, which consist of transition matrices, initial income arrays, growth factors, etc., are read in from a single data tape. They are then simply stored for use by the relevant subroutines. The variable parameters are the particular year being simulated and the rate of inflation that is assumed to apply throughout the simulated period. Both of these variables are read in from cards.

After reading in the rate of inflation, the program is able to calculate a consumer price index vector. This is simply the consumer price index for the 15 years from 1967 to 1981. It will be used to calculate money growth in certain components of a person's income. The CPI vector is the last parameter necessary to effect individual transitions. All of the other sets of data have already been stored, and the program is able to begin to read and process individual records.

Before the income updating processes begin, the program checks to see if the individual is less than 14 years of age. Children less than 14 are assumed by POLSIM to receive no income, and consequently the income variables of all such children are not updated.

All other persons are assumed to be eligible for employment, property and other kinds of income. For employment and retirement incomes, which depend on one's relation to the labour force, a variety of processes exist. The exact transformations that these two sources of income are subject to depend on certain elements in the individual state vector. That is, they depend on just what "kind" of person the given individual is.

The main criterion for determining how a person's employment and retirement income will be updated is his employment category, which, as mentioned earlier, defines the way in which he relates to the labour

force. If he is a person who has entered the labour force for the first time in the current year then he must have an initial income assigned to him. His retirement income will be zero. If the person is a student then an employment income must be assigned if the student worked during the summer. If the person is a non-retired member of the non-labour force then no employment income is assigned. In neither of the above two cases is a retirement income assigned. If a person is retired, then his retirement income is assumed to be the same as in the previous year, and his employment income is zero. If a person is in the labour force and is assumed to be employed for the full year, then his employment income is determined by an annual employment income transition. His retirement income is of course zero. If the person is in the labour force but is assumed to be subject to unemployment then the Activity block has previously determined how many weeks he has worked, and the Market Income block now determines any change in his weekly wage. His employment income for the year is then the product of these two variables. His retirement income is zero. If the person is in his first year of retirement (he has just reached age 65), and he is not eligible for a private pension, then in the present version of the model he is assumed to have no private retirement or employment income at all. If a person has just retired and is assumed to be eligible for a private pension, then his pension is calculated and becomes the whole of his retirement income. His employment income is zero.

It will be recalled that property income consists of two components, dividends and other investment income. The transition processes that apply to dividends are exactly equivalent to those that apply to other investment income. The only difference between the two is that the probabilities defining the two processes are different. But the processes themselves, the definition of the cells in the transition matrices, and the variables on which the matrices are stratified are exactly the same.

The updating of "property income" can be divided into two sections, depending on how much initial property income the person in question has. The first applies only to persons whose property income is less than $250 and embraces those persons who are moving from zero to non-zero property incomes for the first time. For people in this group, transitions to other classes depend on both age and income. A random number samples a cumulative probability distribution which is contingent on the person's age and income. The sampling defines the new property income class, and hence the new property income (which is taken to be the midpoint of the class).

The second set of transitions, which apply only to those whose initial property income is greater than $250, is virtually identical to the first. The only difference is that the transition matrices depend on

age only, rather than age and income. The idea behind this distinction is that total income is relevant in determining the level of property income a person is likely to achieve in the first instance. That is, the larger the person's total income, the larger his savings are likely to be. And the larger the person's savings, the larger his initial property income. Whether this initial amount of savings is then further built up or drawn down depends mainly on the stage of the life cycle, i.e., age.

Other money income consists of room and board income, alimony, and other small items of income which are difficult to simulate. Because this kind of income is small, and confined to very few people, it is handled in a simple deterministic way. The only persons allowed to have other money income are those who had some in the previous year. The size of the current year amount is increased, however, to reflect any changes in the CPI.

Once all of the components of an individual's income have been determined, his total income for the simulated year is computed by simple summation. This total is then recorded in the individual's state vector.

4. Model Simulation: 1967 to 1971

The complete POLSIM model was tested by simulating the four year period from 1967 to 1971. The initial year population for the simulation consisted of 397,960 individual records derived from the 1967 Survey of Consumer Finance. The input parameters to the simulation (unemployment rates, total number of immigrants, and rates of wage inflation) were the actual values that obtained over the four year period. The present section discusses the results of this simulation.

The results of the simulation of new immigrants over the four year period are summarized in Table 1. It can be seen that the model slightly underestimates the total number of immigrants, even though the actual number is an exogenous input. The reason for this is that children are created stochastically in the Immigration Block, and that slight adjustments have to be made to the number of married women so as to equate them with the number of married men.

The results of the Demographic Block processes are summarized in Tables 2 to 5. The aggregate totals produced by the Demographic Block are compared with actual figures derived from Vital Statistics. In general, the model performs very well. The tables indicate that the model tends to underestimate the number of live births, deaths and divorces while overestimating the number of marriages.

The results of the birth process are given in table 2, and it can be seen that the simulation begins with a fairly large error in 1968 which then declines until 1971 when the results are almost perfect. Part of the error in the early years (approximately 15,000 live births) can be attributed to initial population errors. In particular, the initial population is largely underestimated for women in the 20-24 age group, and since this is the prime child-bearing age, a large underestimate in births will naturally ensue. The underestimate in births declines as the simulation progresses for two reasons. First the model uses stationary fertility probabilities estimated for the latest year. The birth rate declined over the period 1967-1971, and since this was not reflected in the probabilities, one would expect any underestimate to decline as time goes forward. Second, the underestimate will also decline as time progresses because the effect of the initial population error will decrease. In the initial population, females in the 15-19 age group are only slightly underestimated (as compared with the large underestimate in the 20-24 age group). Therefore in each succeeding year, the 20-24 female age group will more closely approximate the true population in that age group, and hence the underestimate in births which results from an underestimate in the 20-24 population will progressively be eliminated. In examining the regional results, table 2 indicates that there is no evidence that fertility probabilities should be regionalized.

Table 3 indicates that marriages are slightly overestimated. This can be explained by the fact that any individual of marital status "other" is, in the model, eligible for marriage. We recall that the state-variable marital-status can attain three state-codes, i.e. single, married, and other. The "other" includes the widowed, separated and divorced. Including the separated into the eligible population for marriage clearly introduces positive biases.

The divorce process results are given in table 4, and are much better than expected. It is known that Canada passed through a transient period during the time of the simulation, insofar as the incidence of divorces is concerned, due to a change in the divorce law in 1969. This made the simulation of divorce quite difficult, and hence the results are on the whole quite pleasing. It is obvious, however, that the regionalization of the divorce probabilities should be seriously considered. In 1970, for example, the model significantly overestimates the number of divorces in Quebec while underestimating the number in Ontario. It is clear that the number of divorces in these two processes cannot be considered to be outcomes of the same stochastic process.

It can be seen from table 5 that the death process results in an underestimate in the number of simulated deaths. This underestimate is 9.4%, 13.6% 11.1% and 8.2% respectively in the years 1968 through 1971. Most of this error (approximately 8%) is a consequence of the initial population underestimate, while simulation error can account for another -4%.

Table 6 compares the sex-region populations produced by POLSIM with the same distributions as reported by Vital Statistics. It can be seen that there is a general underestimation on the part of the model. This can be explained by the fact that the Survey of Consumer Finance underestimates the total population (by excluding the Yukon and N.W.T., military personnel, and persons in institutions) and because the model itself underestimated the number of births in each of the simulated years. Over the four year period the underestimation in population that can be attributed to the model itself is 128,276 (sum of underestimates in births less sum of underestimates in deaths). The total underestimate in the 1971 simulated population is seen from table 6 to be 780,260. Of this total, 16% can be crudely attributed to the error generated by the model while 84% can be attributed to the error in the initial year population. This is in fact an upper estimate of the model error. The fact that the initial population is too small to begin with implies that one would expect an underestimate in the number of births and deaths. Therefore part of the underestimate arising from the model is in fact attributable to the error in initial year population.

The results of the labor force simulations are summarized briefly in table 7 and Figure 2. Table 7 presents the unemployment rates, by sex, that the model produces over the entire four year period and compares these

with the actual rates for the same period as measured by the labor force survey. Figure 2 plots the monthly aggregate simulated unemployment rate and the monthly aggregate actual unemployment rate over the four year period. It can be seen that the model tracks the unemployment rate very well, and there is no tendency for it to get "off-track" as time progresses. There is a slight tendency, however, for the simulated rate to be too high. This was expected, because the simulation parameters are adjusted to fit the higher unemployment rates of the period April 1972 to April 1973. This adjustment was such as to increase the resulting simulated unemployment rate slightly from that which would have resulted from the original equations. Since the original regression equations of the labor-force model had been fitted to data from the 1959-1969 period, the adjustment would be expected to simulate too many unemployed persons over the four years 1967-71. The adjusted equations would be expected to perform better over a four year period beginning in 1971.

The Market Income simulation is summarized in Tables 8-10. For each of the component incomes (employment income, property income, and retirement income) distributions for the four simulated years are presented. As standards of comparison, the same distributions from the 1967 and 1971 SCF surveys are also given. It can be seen that the simulations perform as one would expect; there is a

general tendency for the distributions to shift to the right as time progresses. Since no adequate income data exists for the years between 1967 and 1971, it is not possible to examine how well the simulations perform year by year. All that can be compared are the final results (the distributions for the year 1971). It should be noted that the comparisons for property income in Table 9 are not really meaningful, due to the fact that the 1967 survey did not distinguish between dividend and interest income. As a result, the model simulated total property income with interest income transition matrices, and hence the resulting final simulated property income is not strictly comparable with the results obtained from the 1971 SCF survey.

Table 1

Comparison of simulated and actual data*

Total number of immigrants: 1968-71

	Simulated	Actual
1968	180,250	183,974
1969	157,850	161,531
1970	144,200	147,713
1971	118,450	121,900

* Source: Immigration Statistics

Table 2

Comparison of simulated and actual data*

Live Births by Region: 1968-71

		Atlantic	Quebec	Ontario	Prairies	B.C.	Canada
968	Simulated	26,750	81,600	104,000	44,300	28,350	285,000
	Actual	40,306	96,622	126,257	65,770	33,687	364,310
969	Simulated	27,050	87,150	114,050	48,550	30,000	306,800
	Actual	40,322	95,610	130,398	66,256	35,383	369,647
970	Simulated	29,050	92,000	124,200	53,250	33,500	332,000
	Actual	40,200	91,757	134,724	66,658	36,861	371,988
971	Simulated	32,800	94,850	129,800	55,350	36,150	348,950
	Actual	41,307	89,210	130,395	64,630	34,852	362,187

* Source: Vital Statistics - Statistics Canada Catalogue 84-201.

Table 3

Comparison of simulated and actual data*

Marriages by Region: 1968-71

		Atlantic	Quebec	Ontario	Prairies	B.C.	Canada
1968	Simulated	18,200	54,050	70,775	35,525	20,850	199,400
	Actual	16,665	46,004	62,109	29,678	16,914	171,766
1969	Simulated	18,500	55,375	71,425	32,450	19,700	187,450
	Actual	17,420	47,545	67,150	31,378	18,284	182,183
1970	Simulated	19,800	55,600	73,625	34,900	19,950	203,875
	Actual	17,875	49,607	68,874	31,610	20,026	188,429
1971	Simulated	19,950	56,475	74,350	35,000	21,475	207,250
	Actual	18,678	49,695	69,590	32,554	20,389	191,324

Table 4

Comparison of simulated and actual data*

Divorces by Region: 1968-71

		Atlantic	Quebec	Ontario	Prairies	B.C.	Canada
1968	Simulated	1,675	5,975	7,825	3,325	1,750	20,550
	Actual	675	606	5,036	2,765	2,220	11,343
1969	Simulated	1,550	6,075	7,800	3,550	1,825	20,800
	Actual	1,362	2,930	11,843	5,648	4,224	26,079
1970	Simulated	1,400	6,450	8,350	2,950	2,600	21,750
	Actual	1,414	4,865	12,451	5,876	5,111	29,775
1971	Simulated	2,000	5,975	8,450	2,800	2,400	21,625
	Actual	1,413	5,195	12,189	5,835	4,942	29,626

* Source: Vital Statistics - Statistics Canada Catalogue 84-201.

Table 5

Comparison of simulated and actual data*

Deaths by Region: 1968-71

		Atlantic	Quebec	Ontario	Prairies	B.C.	Canada
1968	Simulated	14,750	33,200	50,800	24,350	15,800	138,900
	Actual	15,628	39,537	55,552	25,339	16,828	153,196
1969	Simulated	13,850	31,900	47,650	25,450	14,600	133,450
	Actual	15,524	40,103	55,707	25,453	17,377	154,477
1970	Simulated	13,650	33,300	51,000	23,900	15,200	137,050
	Actual	15,977	40,392	56,769	25,440	17,020	155,961
1971	Simulated	14,950	32,800	51,450	26,550	18,650	144,400
	Actual	15,831	40,738	56,623	25,963	17,783	157,272

* Source: Vital Statistics - Statistics Canada Catalogue 84-201.

Table 6

Comparison of simulated and actual data*

Population Distribution by Sex and Region: 1968-71

		Atlantic	Quebec	Ontario	Prairies	B.C.	Canada
1968	Male Simulated	986,800	2,920,200	3,495,800	1,643,250	991,750	10,037,800
	Male Actual	1,009,300	2,956,600	3,649,800	1,753,000	1,016,400	10,409,900
	Female Simulated	977,450	2,952,600	3,541,850	1,615,400	953,150	10,040,450
	Female Actual	991,700	2,970,400	3,656,200	1,704,000	990,600	10,334,100
1969	Male Simulated	984,950	2,933,000	3,561,300	1,647,400	1,021,750	10,148,400
	Male Actual	1,013,800	2,982,400	3,721,800	1,773,500	1,046,800	10,563,600
	Female Simulated	973,100	2,962,700	3,619,850	1,621,250	985,000	10,161,900
	Female Actual	998,200	3,001,600	3,730,200	1,725,500	1,020,200	10,497,400
1970	Male Simulated	982,350	2,945,450	3,631,000	1,650,250	1,051,900	10,260,950
	Male Actual	1,015,400	2,993,000	3,812,000	1,783,100	1,082,800	10,712,600
	Female Simulated	972,250	2,974,800	3,696,200	1,628,500	1,018,550	10,290,300
	Female Actual	1,002,600	3,020,000	3,825,000	1,739,900	1,054,200	10,664,400
1971	Male Simulated	980,200	2,955,150	3,700,550	1,661,450	1,078,200	10,375,550
	Male Actual	1,038,215	2,994,550	3,840,905	1,793,115	1,100,375	10,795,370
	Female Simulated	973,100	2,983,750	3,767,850	1,641,500	1,046,300	10,412,500
	Female Actual	1,019,040	3,033,215	3,862,200	1,749,240	1,084,245	10,772,940

* Source: Vital Statistics - Statistics Canada Catalogue 84-201.

Table 7

Comparison of simulated and actual data

UNEMPLOYMENT RATES: 1968-71

		APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL
Canada Total														
1968	Simulated	5.4	5.0	5.6	5.1	4.3	3.9	4.6	4.8	5.2	6.1	5.8	5.5	5.3
	Actual	5.7	4.6	4.8	4.5	3.9	3.3	3.6	4.2	4.7	5.9	6.0	5.7	5.4
1969	Simulated	5.3	5.3	5.8	5.1	4.4	4.1	4.8	5.0	5.3	6.4	6.4	6.6	6.5
	Actual	5.4	4.7	4.6	4.1	3.7	3.4	3.9	4.4	4.7	6.1	6.5	6.7	6.6
1970	Simulated	6.5	6.5	6.7	6.4	5.6	5.2	5.8	6.3	7.3	8.8	8.7	8.5	8.5
	Actual	6.6	6.1	6.1	5.9	5.1	4.7	5.0	5.7	6.5	8.0	8.1	7.8	7.8
1971	Simulated	8.4	5.9	7.0	6.3	5.6	5.5	5.9	6.4	6.9	8.4	7.8	7.9	7.3
	Actual	7.8	6.3	6.2	5.7	5.1	5.0	5.1	5.8	6.1	7.7	7.3	7.4	6.8
Male														
1968	Simulated	6.3	5.4	5.7	5.1	4.2	3.6	3.9	4.7	5.5	6.5	6.2	5.9	5.5
	Actual	6.7	5.3	5.1	4.7	3.9	3.3	3.8	4.8	5.4	6.8	7.1	6.7	6.2
1969	Simulated	5.5	5.6	5.8	5.2	4.3	4.0	4.4	5.0	5.7	7.1	7.1	7.4	7.1
	Actual	6.2	5.1	4.8	4.3	3.8	3.4	4.0	4.7	5.4	7.0	7.6	8.1	7.9
1970	Simulated	7.2	7.1	7.1	6.9	5.9	5.3	5.8	6.8	8.4	10.2	10.1	10.1	9.9
	Actual	7.9	6.9	6.5	6.2	5.3	5.0	5.2	6.1	7.3	9.2	9.3	9.2	9.0
1971	Simulated	9.7	7.7	7.5	6.8	5.8	5.6	5.9	6.9	7.8	9.9	9.1	9.4	8.3
	Actual	9.0	6.9	6.6	6.0	5.2	5.1	5.1	6.2	7.0	8.6	8.2	8.4	7.8
Female														
1968	Simulated	3.3	4.1	5.5	4.9	4.7	4.6	6.0	5.2	4.7	5.2	5.0	4.6	4.7
	Actual	3.4	3.3	4.2	3.9	3.7	3.2	3.3	3.1	3.1	4.0	3.7	3.4	3.5
1969	Simulated	4.8	4.9	5.7	4.9	4.7	4.5	5.6	4.9	4.5	5.1	5.2	4.9	5.1
	Actual	3.5	3.7	4.1	3.5	3.5	3.4	3.6	3.6	3.3	4.1	4.2	3.8	4.0
1970	Simulated	5.2	5.3	5.8	5.4	5.1	4.8	5.9	5.4	5.3	6.0	5.9	5.5	5.9
	Actual	4.0	4.2	5.2	5.3	4.7	4.3	4.6	4.7	4.7	5.5	5.5	5.0	5.5
1971	Simulated	6.0	5.4	6.0	5.2	5.0	5.2	6.0	5.5	5.1	5.7	5.4	5.1	5.3
	Actual	5.5	5.0	5.5	5.0	4.8	4.8	5.2	5.0	4.4	6.0	5.5	5.5	4.9

Table 8

Employment Incomes

Income Categories in $	Base '67	Final '68	Final '69	Final '70	Final '71	Base '71
0 - 999	13,480,300 66.90%	12,590,950 62.48	12,454,450 61.03	12,522,250 60.58	12,533,000 59.92	13,933,050 64.76
1K - 1999	842,250 4.18	1,272,500 6.31	1,258,800 6.17	1,211,950 5.86	1,152,900 5.51	799,550 3.72
2K - 2999	879,700 4.37	1,253,400 6.22	1,264,500 6.20	1,233,950 5.97	1,227,050 5.87	687,700 3.20
3K - 3999	998,550 4.95	1,012,100 5.02	1,070,200 5.24	1,082,550 5.24	1,095,550 5.24	771,400 3.59
4K - 4999	999,100 4.96	900,000 4.47	957,800 4.69	970,800 4.70	933,800 4.46	820,400 3.81
5K - 5999	917,900 4.55	752,350 3.73	756,650 3.71	769,000 3.72	834,850 3.99	774,150 3.60
6K - 6999	711,300 3.53	638,950 3.17	595,300 2.92	610,800 2.96	629,200 3.01	705,500 3.28
7K - 7999	423,550 2.10	473,250 2.35	494,150 2.42	485,600 2.35	492,700 2.36	675,800 3.14
8K - 8999	289,350 1.44	306,750 1.52	357,950 1.75	396,300 1.92	442,600 2.12	602,150 2.80
9K - 9999	164,800 .82	240,900 1.20	257,950 1.26	259,600 1.26	271,250 1.30	451,250 2.10
10K - 14999	300,850 1.49	559,650 2.78	747,650 3.66	874,700 4.23	957,850 4.58	953,500 4.43
15K - 19999	72,900 .36	93,300 .46	132,050 .65	186,950 .90	249,300 1.19	189,400 .88
20K - 24999	24,700 .12	24,850 .12	21,950 .11	12,600 .06	37,100 .18	57,950 .27
25K +	47,200 .23	33,500 .17	37,650 .18	52,550 .25	59,600 .28	93,850 .44
Total	20,152,450 99.99	20,152,450 100.00	20,407,050 99.99	20,669,600 100.00	20,916,750 100.01	21,515,650 100.02

Table 9

Property Incomes

Income Categories in $	Base '67	Final '68	Final '69	Final '70	Final '71	Base '71
0	18,417,450	16,597,100	15,666,000	15,119,550	14,806,200	18,008,550
	91.39%	82.36	76.77	73.15	70.79	83.70
1 - 250	857,900	2,525,700	3,460,350	4,010,650	4,331,250	2,200,400
	4.26	12.53	16.96	19.40	20.71	10.23
251 - 500	268,200	298,350	405,650	503,100	589,850	413,450
	1.33	1.48	1.99	2.43	2.82	1.92
501 - 750	152,600	187,400	224,050	271,850	306,100	202,500
	.76	.93	1.10	1.32	1.46	.94
751 - 1000	117,000	115,700	142,600	172,400	196,350	157,850
	.58	.57	.70	.83	.94	.73
1K - 1999	183,650	235,300	267,900	308,300	353,800	268,400
	.91	1.17	1.31	1.49	1.69	1.25
2K - 2999	72,500	74,650	89,350	103,950	122,050	111,350
	.36	.37	.44	.50	.58	.52
3K - 3999	29,600	51,200	64,200	74,100	83,900	54,350
	.15	.25	.31	.36	.40	.25
4K - 4999	16,900	22,050	26,900	33,900	40,400	34,500
	.08	.11	.13	.16	.19	.16
5K - 5999	10,850	13,700	19,200	21,000	24,950	15,300
	.05	.07	.09	.10	.12	.07
6K - 6999	7,800	7,350	9,050	11,300	14,500	13,650
	.04	.04	.04	.05	.07	.06
7K - 7999	4,850	7,650	9,200	10,100	12,450	7,250
	.02	.04	.05	.05	.06	.03
8K +	13,150	16,300	22,600	29,400	34,950	28,100
	.07	.08	.11	.14	.17	.13
Total	20,152,450	20,152,450	20,407,050	20,669,600	20,916,750	21,515,650
	100.00	100.00	100.00	99.98	100.00	99.99

Table 10

Retirement Incomes

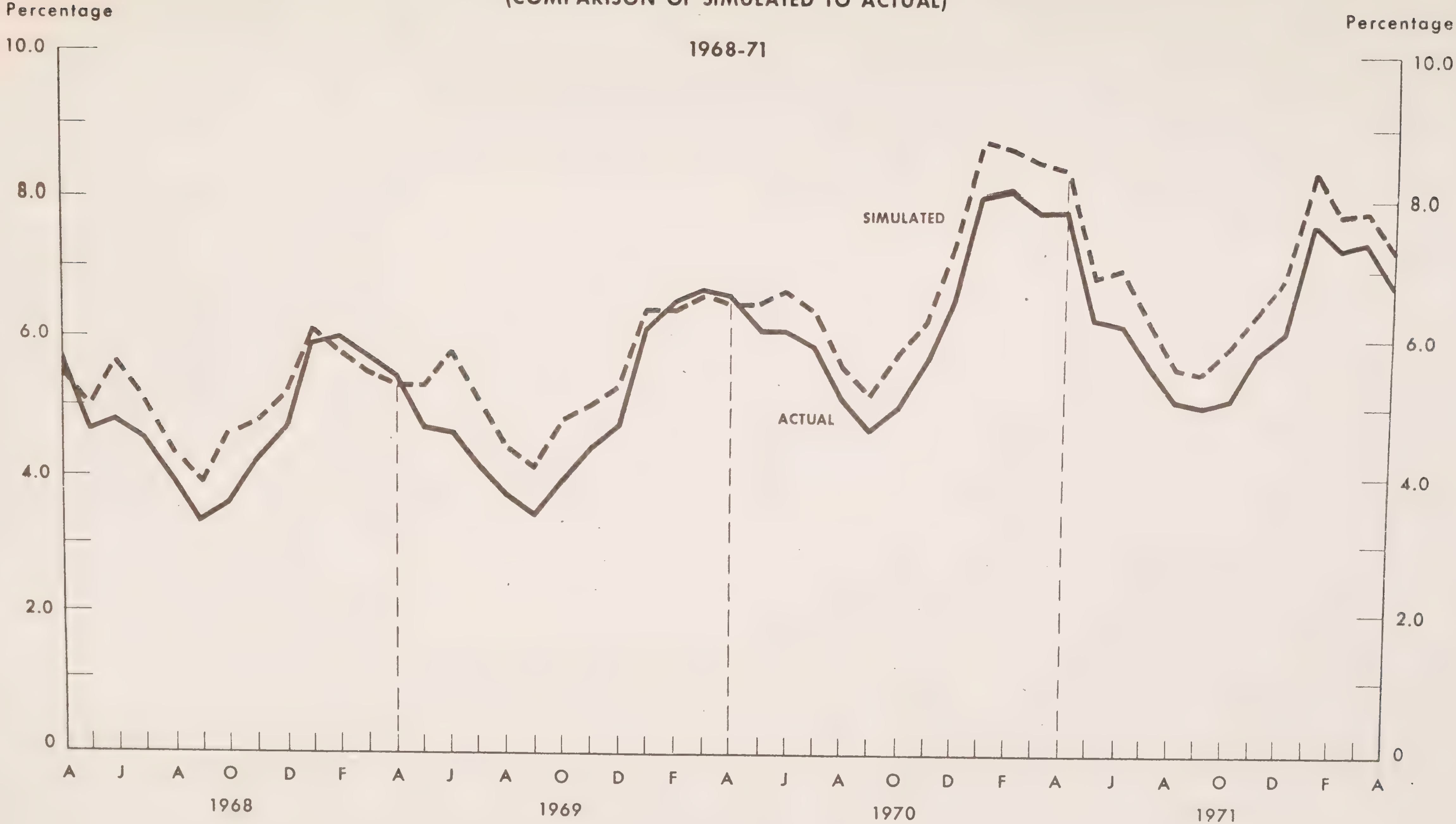
Income Categories in $	Base '67	Final '68	Final '69	Final '70	Final '71	Base '71
0	19,775,350 98.13%	19,768,300 98.09	20,002,200 98.02	20,244,100 97.94	20,474,100 97.88	20,989,150 97.55
1 - 250	41,650 .21	43,400 .22	49,300 .24	53,800 .26	57,050 .27	62,350 .29
251 - 500	51,200 .25	50,850 .25	53,850 .26	56,100 .27	57,200 .27	66,700 .31
501 - 750	41,750 .21	40,600 .20	42,850 .21	44,400 .21	46,300 .22	51,800 .24
751 - 1000	45,250 .22	46,550 .23	46,600 .23	47,550 .23	48,100 .23	47,700 .22
1K - 1999	102,500 .51	104,250 .52	107,100 .52	109,700 .53	112,000 .54	127,100 .59
2K - 2999	52,650 .26	54,250 .27	55,800 .27	58,750 .28	59,900 .29	73,450 .34
3K - 3999	22,700 .11	23,350 .11	24,250 .12	25,000 .13	27,800 .13	42,200 .20
4K - 4999	11,700 .06	10,550 .05	11,750 .06	13,500 .07	15,750 .08	26,300 .12
5K - 5999	4,200 .02	5,150 .03	6,200 .03	6,600 .03	7,800 .04	11,850 .06
6K - 6999	1,400 .01	2,250 .01	2,850 .01	3,750 .02	4,400 .02	6,400 .03
7K - 7999	1,050 .01	1,150 .01	1,600 .01	1,800 .01	1,850 .01	3,100 .01
8K +	1,050 .01	1,800 .01	2,700 .01	3,550 .02	4,500 .02	7,550 .04
Total	20,152,450 100.01	20,152,450 100.00	20,407,050 99.99	20,669,600 100.00	20,916,750 100.00	21,515,650 100.00

Fig.2

CANADA UNEMPLOYMENT RATES - TOTAL

(COMPARISON OF SIMULATED TO ACTUAL)

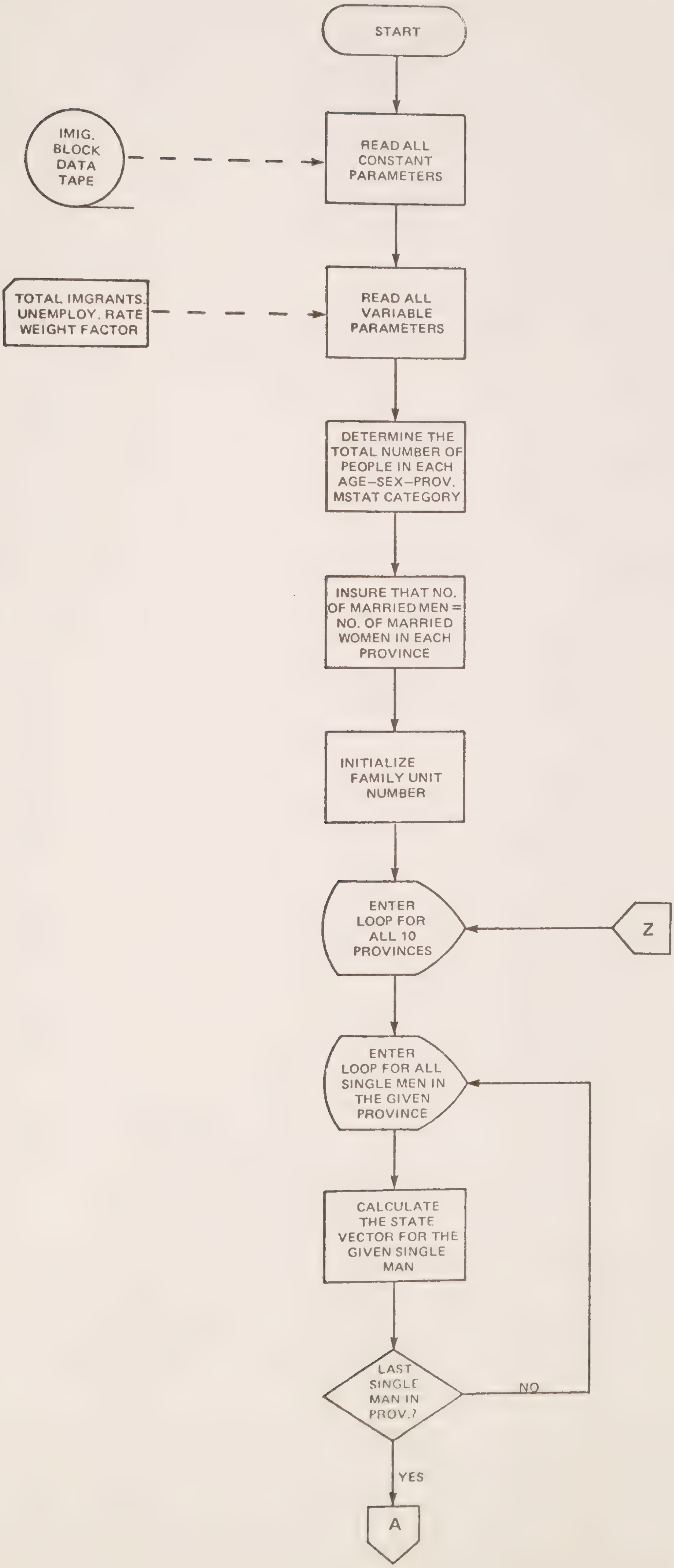
1968-71

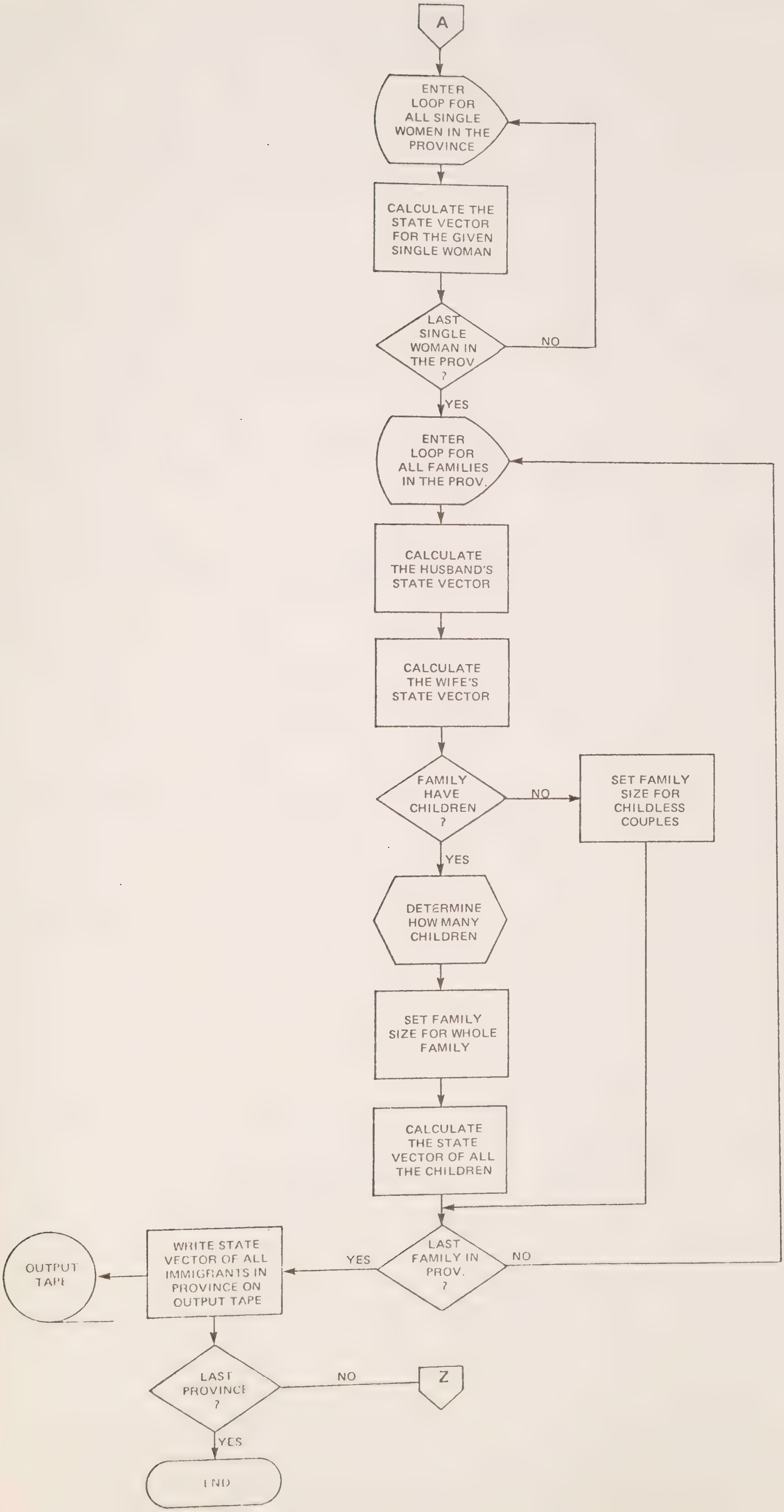


APPENDIX

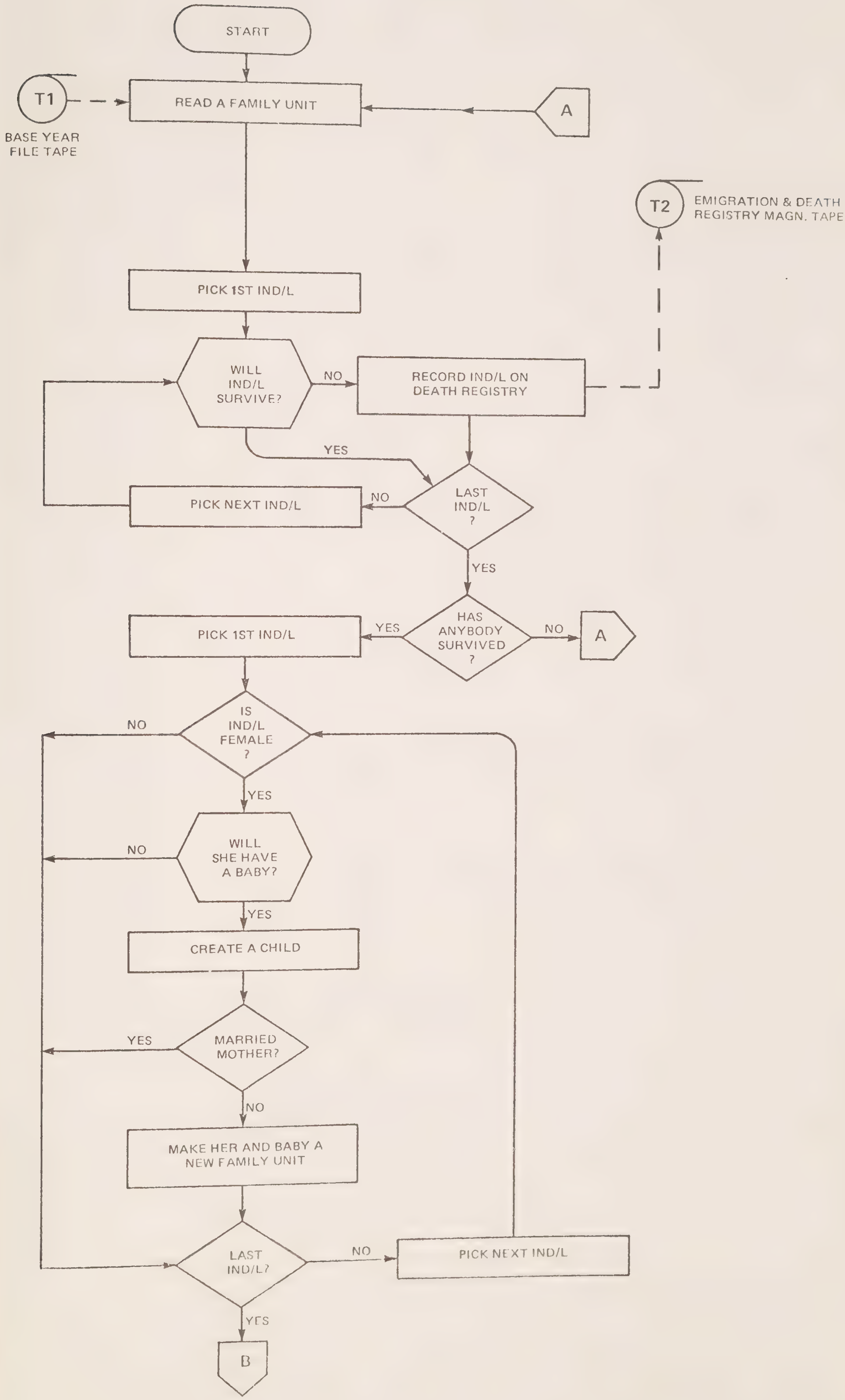
FLOW CHART OF THE POLSIM MODEL

THE IMMIGRATION BLOCK

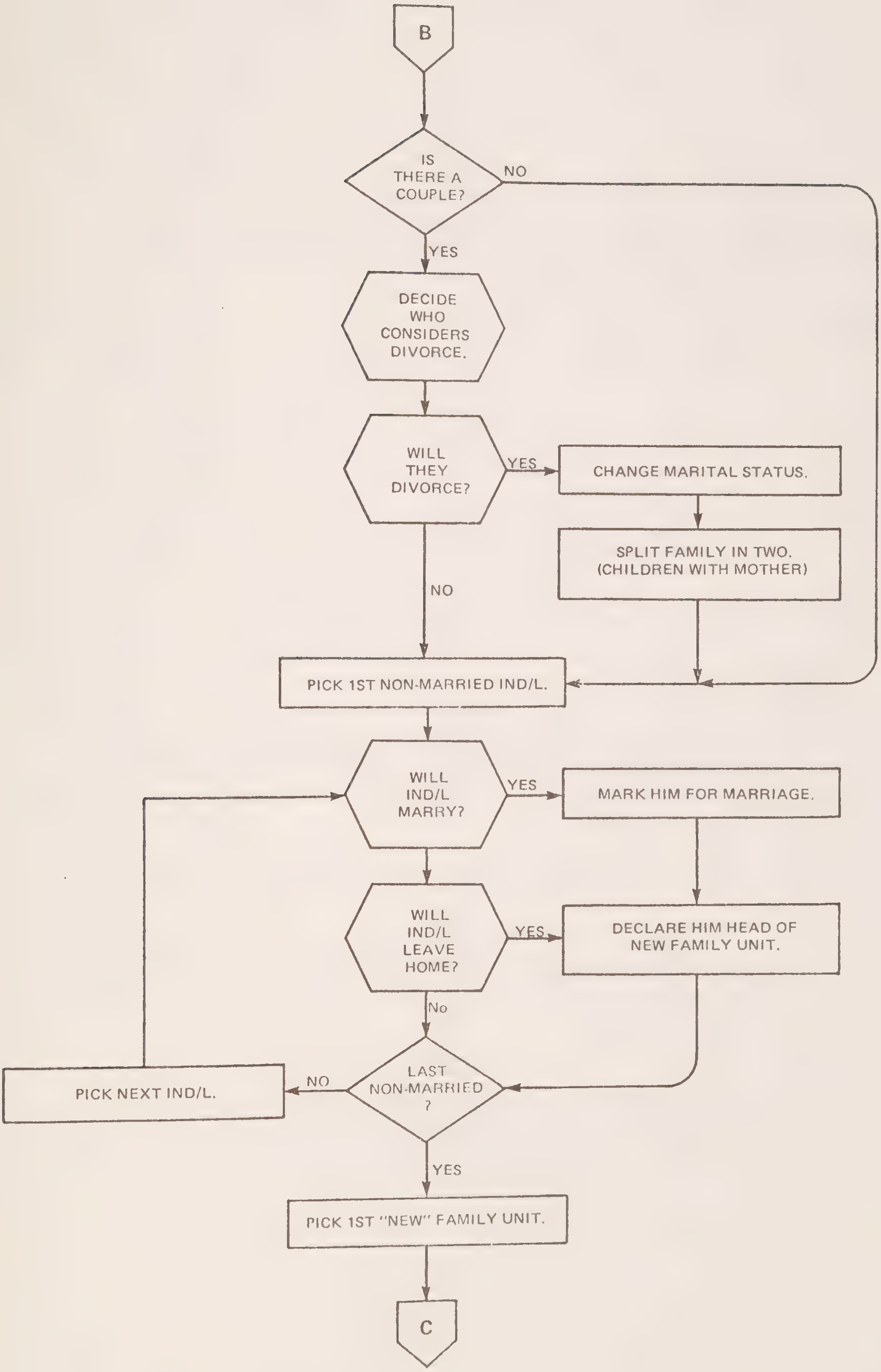


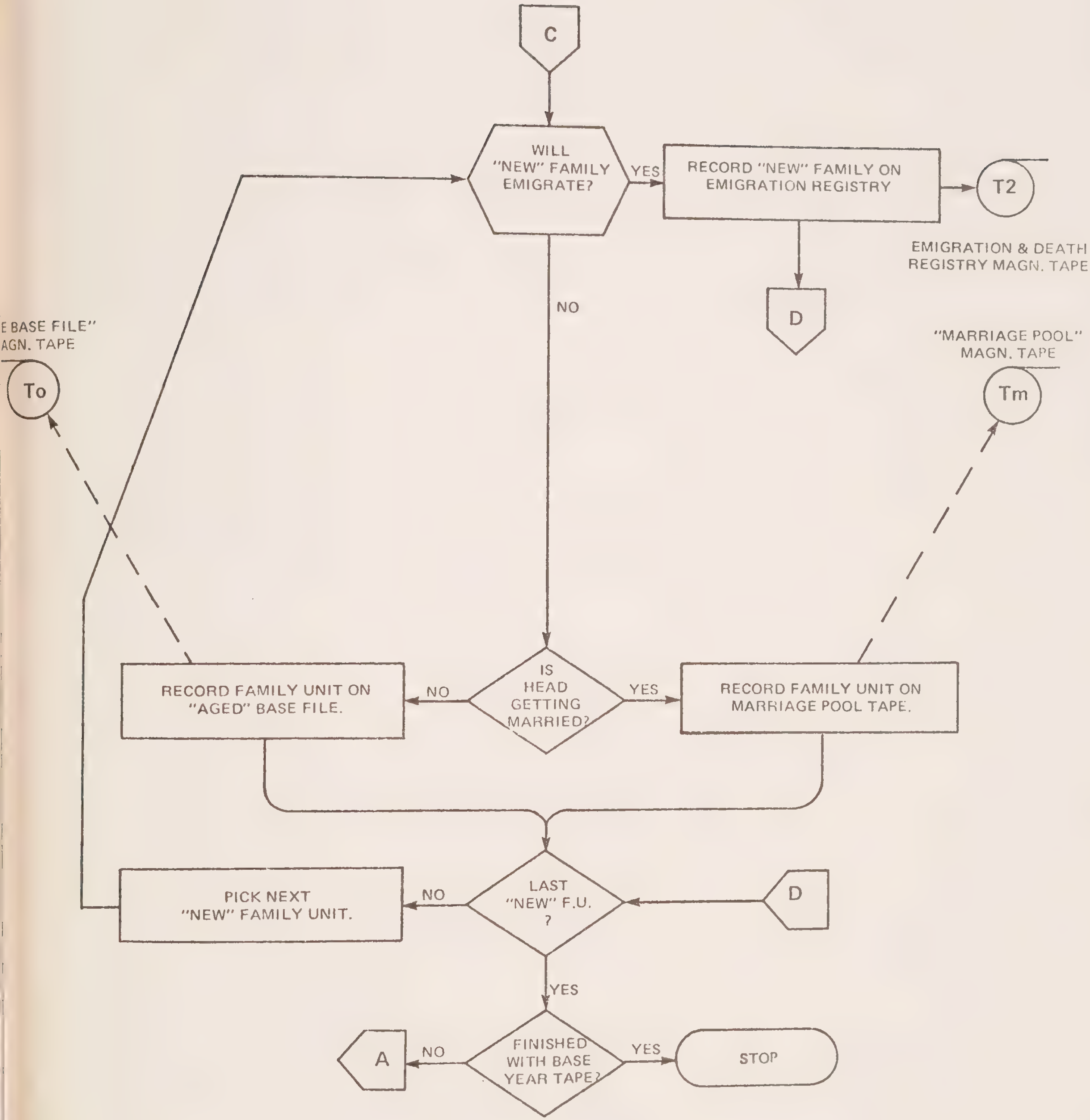

A
ENTER LOOP FOR ALL SINGLE WOMEN IN THE PROVINCE
CALCULATE THE STATE VECTOR FOR THE GIVEN SINGLE WOMAN
LAST SINGLE WOMAN IN THE PROV ?
NO
YES
ENTER LOOP FOR ALL FAMILIES IN THE PROV.
CALCULATE THE HUSBAND'S STATE VECTOR
CALCULATE THE WIFE'S STATE VECTOR
FAMILY HAVE CHILDREN ?
NO
SET FAMILY SIZE FOR CHILDLESS COUPLES
YES
DETERMINE HOW MANY CHILDREN
SET FAMILY SIZE FOR WHOLE FAMILY
CALCULATE THE STATE VECTOR OF ALL THE CHILDREN
LAST FAMILY IN PROV. ?
NO
YES
WRITE STATE VECTOR OF ALL IMMIGRANTS IN PROVINCE ON OUTPUT TAPE
OUTPUT TAPE
LAST PROVINCE ?
NO
Z
YES
END

DEMOGRAPHIC BLOCK FLOW CHART
(PHASE 1)

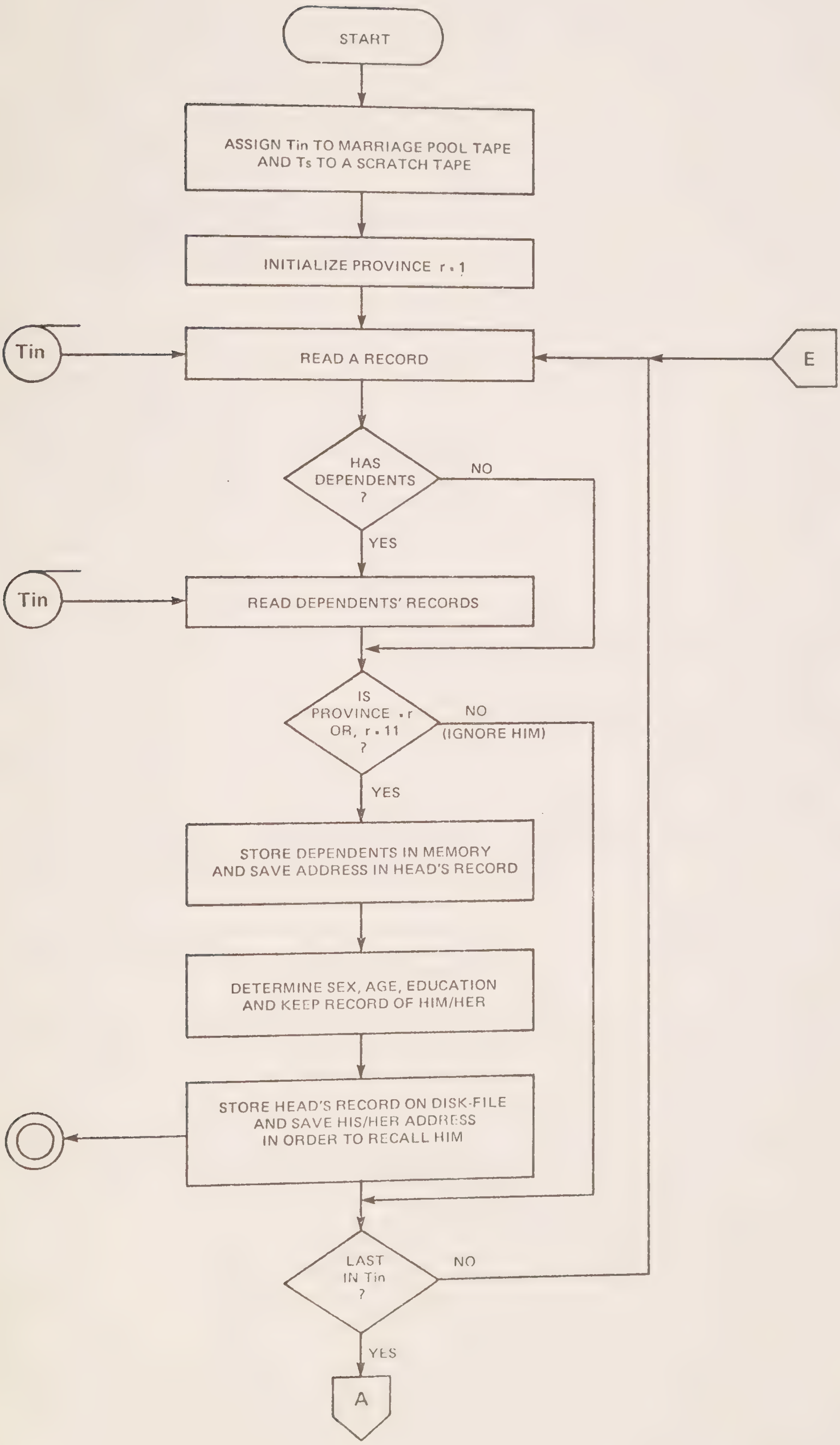


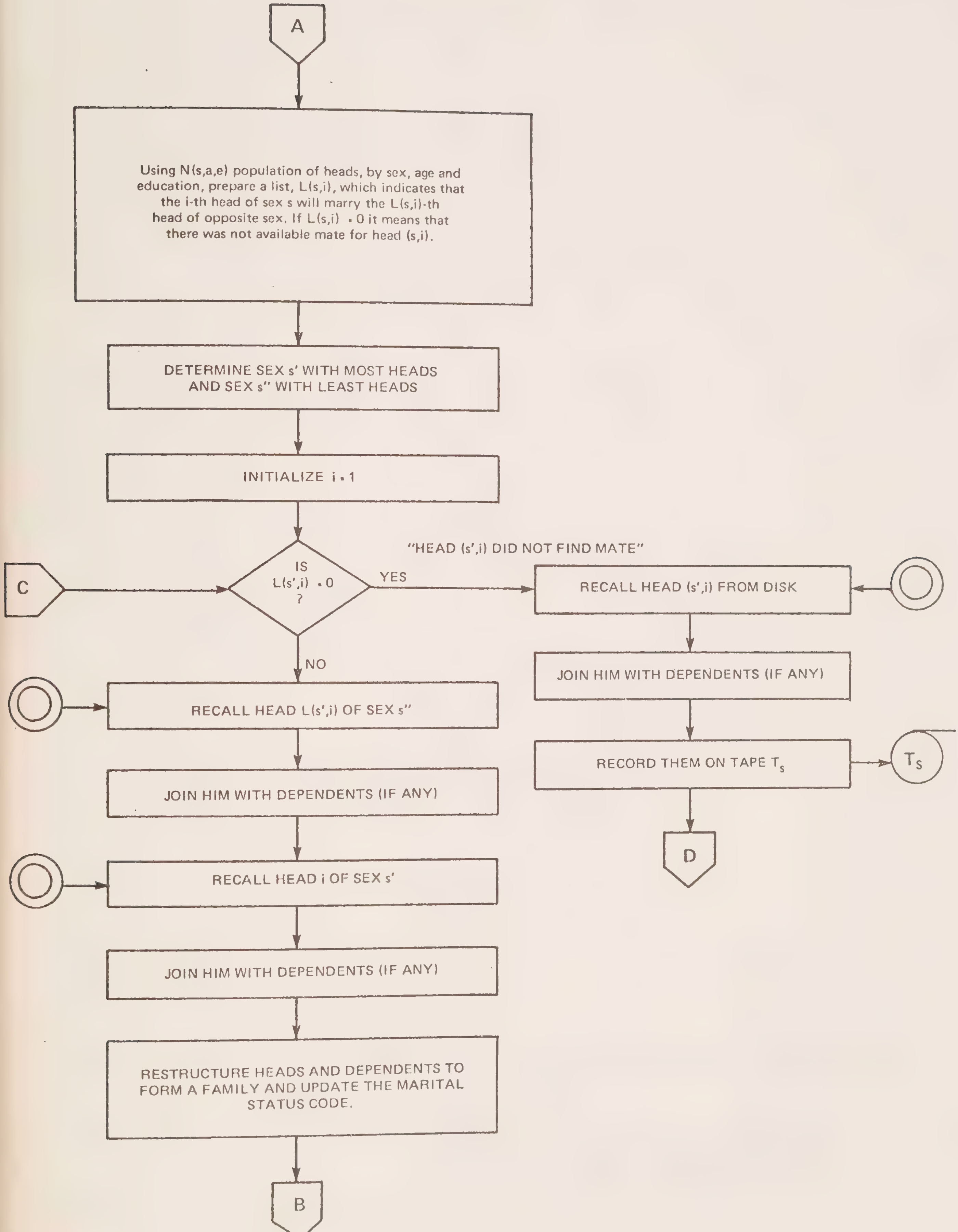
(CONTINUED)

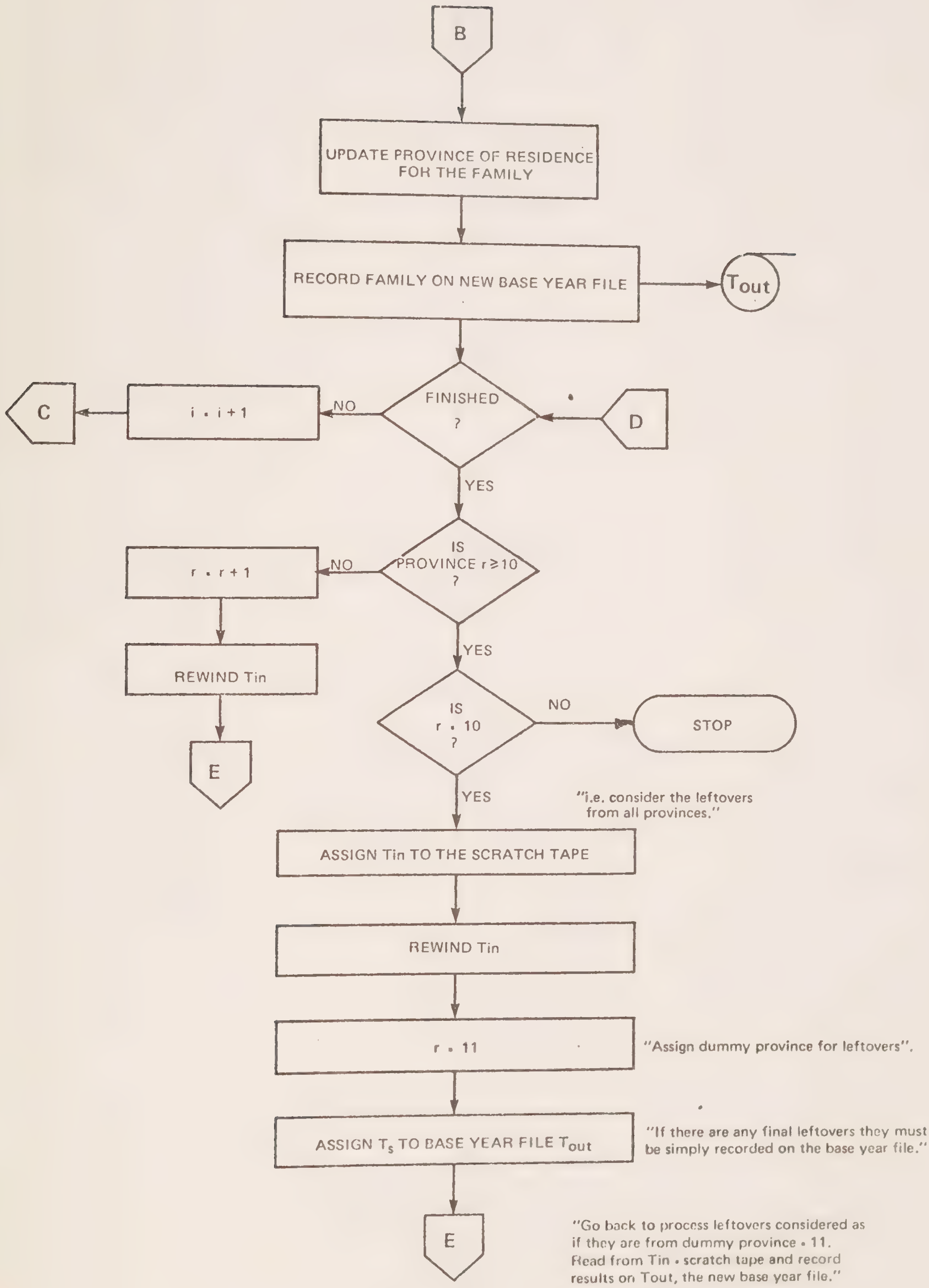

B
IS THERE A COUPLE?
NO
YES
DECIDE WHO CONSIDERS DIVORCE.
WILL THEY DIVORCE?
YES
CHANGE MARITAL STATUS.
SPLIT FAMILY IN TWO. (CHILDREN WITH MOTHER)
NO
PICK 1ST NON-MARRIED IND/L.
WILL IND/L MARRY?
YES
MARK HIM FOR MARRIAGE.
WILL IND/L LEAVE HOME?
YES
DECLARE HIM HEAD OF NEW FAMILY UNIT.
No
LAST NON-MARRIED ?
NO
PICK NEXT IND/L.
YES
PICK 1ST "NEW" FAMILY UNIT.
C


C
WILL "NEW" FAMILY EMIGRATE?
YES
RECORD "NEW" FAMILY ON EMIGRATION REGISTRY
T2
EMIGRATION & DEATH REGISTRY MAGN. TAPE
NO
D
E BASE FILE" AGN. TAPE
To
"MARRIAGE POOL" MAGN. TAPE
Tm
RECORD FAMILY UNIT ON "AGED" BASE FILE.
NO
IS HEAD GETTING MARRIED?
YES
RECORD FAMILY UNIT ON MARRIAGE POOL TAPE.
PICK NEXT "NEW" FAMILY UNIT.
NO
LAST "NEW" F.U. ?
D
YES
A
NO
FINISHED WITH BASE YEAR TAPE?
YES
STOP

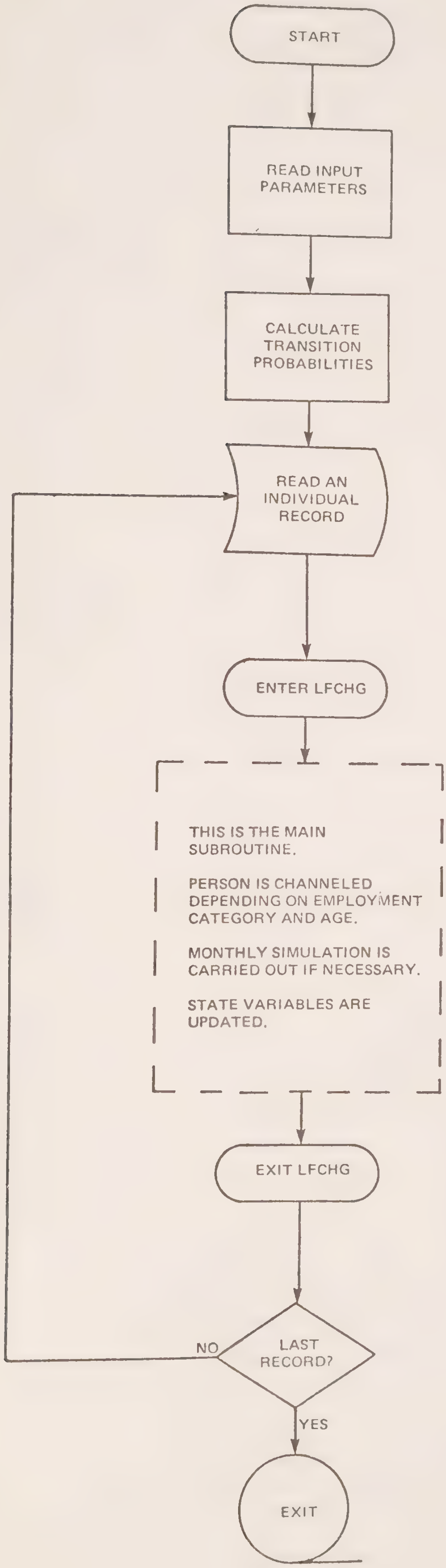
DEMOGRAPHIC BLOCK FLOW CHART
(PHASE 2)




A
Using N(s,a,e) population of heads, by sex, age and education, prepare a list, L(s,i), which indicates that the i-th head of sex s will marry the L(s,i)-th head of opposite sex. If L(s,i) • 0 it means that there was not available mate for head (s,i).
DETERMINE SEX s' WITH MOST HEADS AND SEX s'' WITH LEAST HEADS
INITIALIZE i • 1
C
IS L(s',i) • 0 ?
YES
"HEAD (s',i) DID NOT FIND MATE"
RECALL HEAD (s',i) FROM DISK
JOIN HIM WITH DEPENDENTS (IF ANY)
RECORD THEM ON TAPE T_s
T_s
D
NO
RECALL HEAD L(s',i) OF SEX s''
JOIN HIM WITH DEPENDENTS (IF ANY)
RECALL HEAD i OF SEX s'
JOIN HIM WITH DEPENDENTS (IF ANY)
RESTRUCTURE HEADS AND DEPENDENTS TO FORM A FAMILY AND UPDATE THE MARITAL STATUS CODE.
B

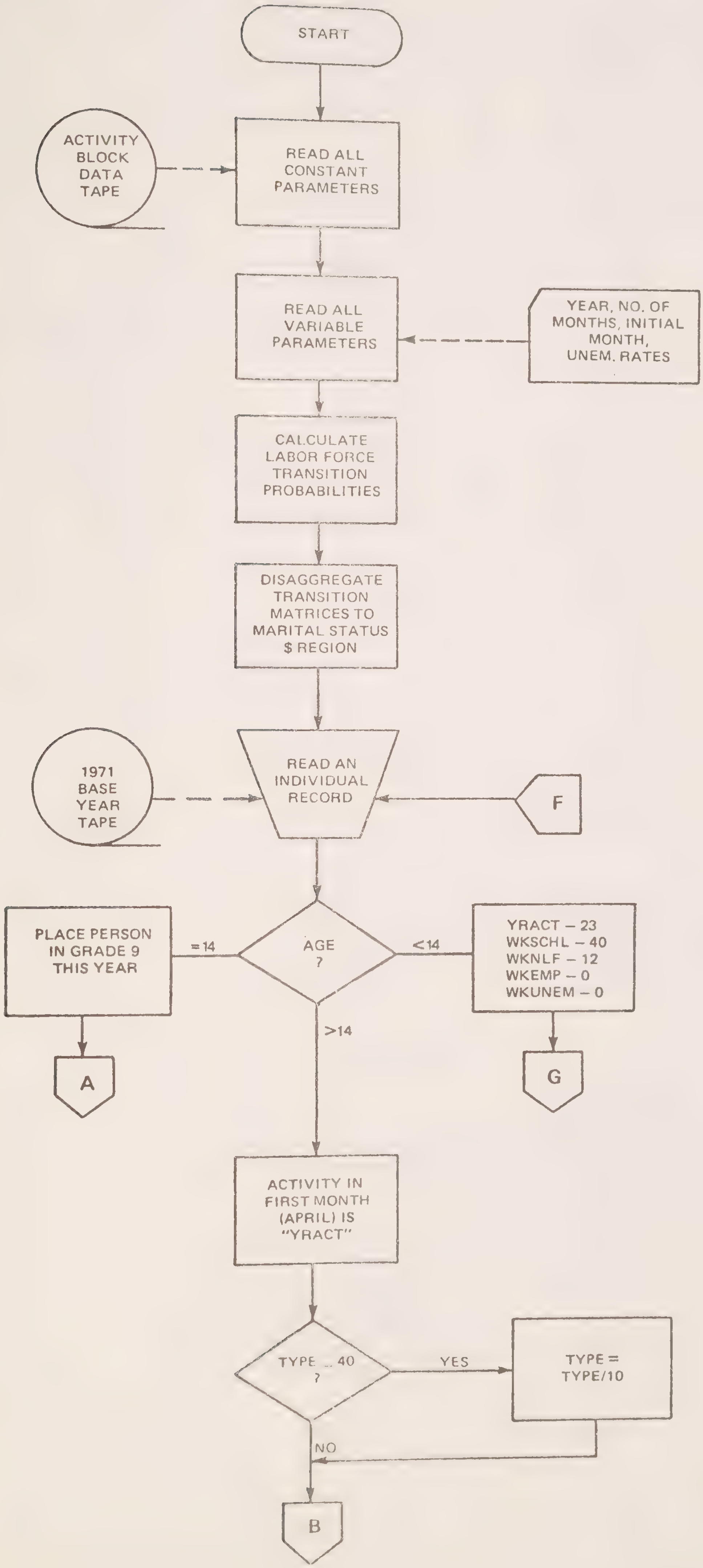

B
UPDATE PROVINCE OF RESIDENCE FOR THE FAMILY
RECORD FAMILY ON NEW BASE YEAR FILE
Tout
FINISHED ?
NO
i = i + 1
C
D
YES
IS PROVINCE r ≥ 10 ?
NO
r = r + 1
REWIND Tin
E
YES
IS r = 10 ?
NO
STOP
YES
"i.e. consider the leftovers from all provinces."
ASSIGN Tin TO THE SCRATCH TAPE
REWIND Tin
r = 11
"Assign dummy province for leftovers".
ASSIGN T_s TO BASE YEAR FILE T_{out}
"If there are any final leftovers they must be simply recorded on the base year file."
E
"Go back to process leftovers considered as if they are from dummy province = 11. Read from Tin = scratch tape and record results on Tout, the new base year file."

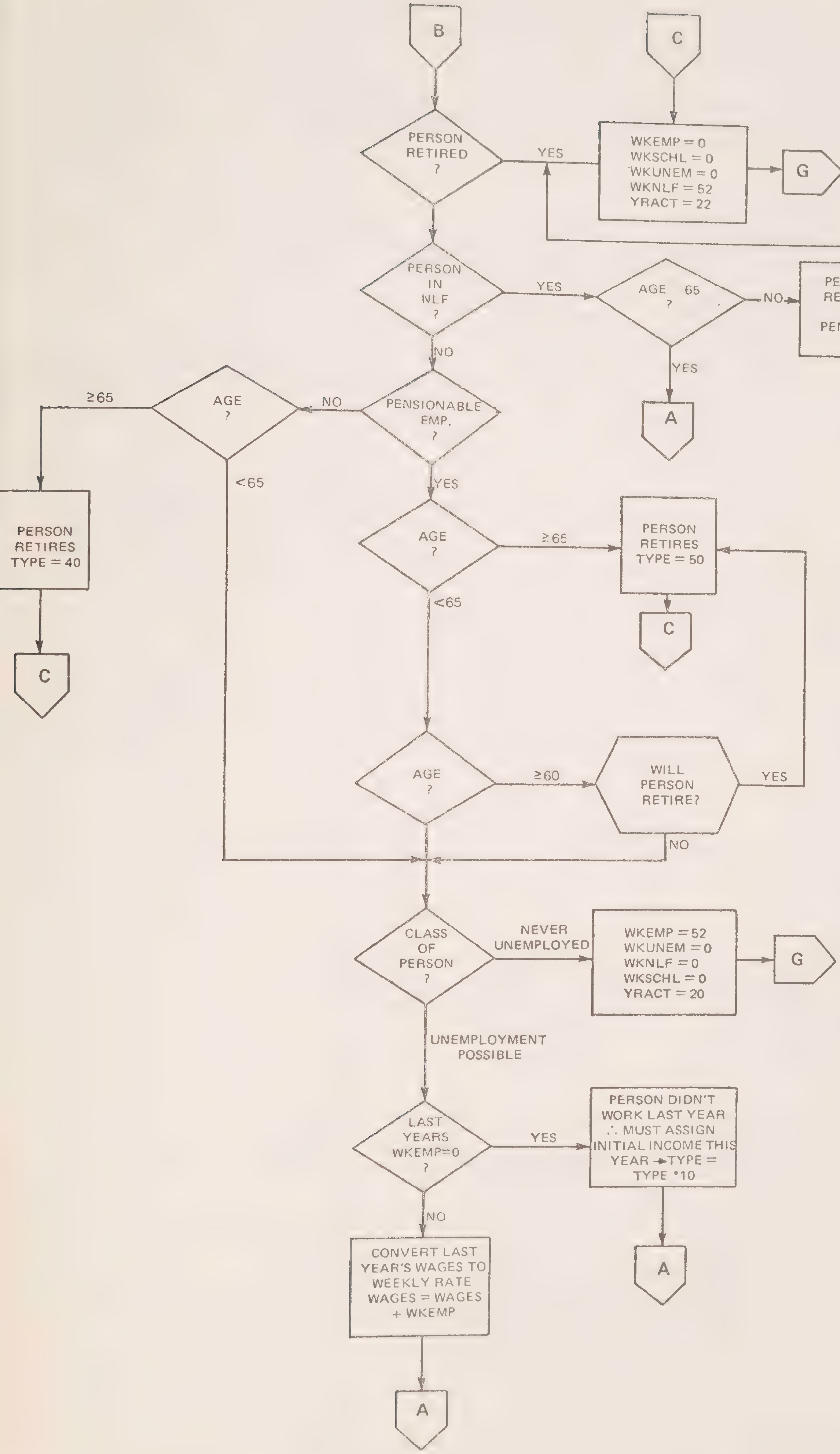
ACTIVITY STATUS BLOCK



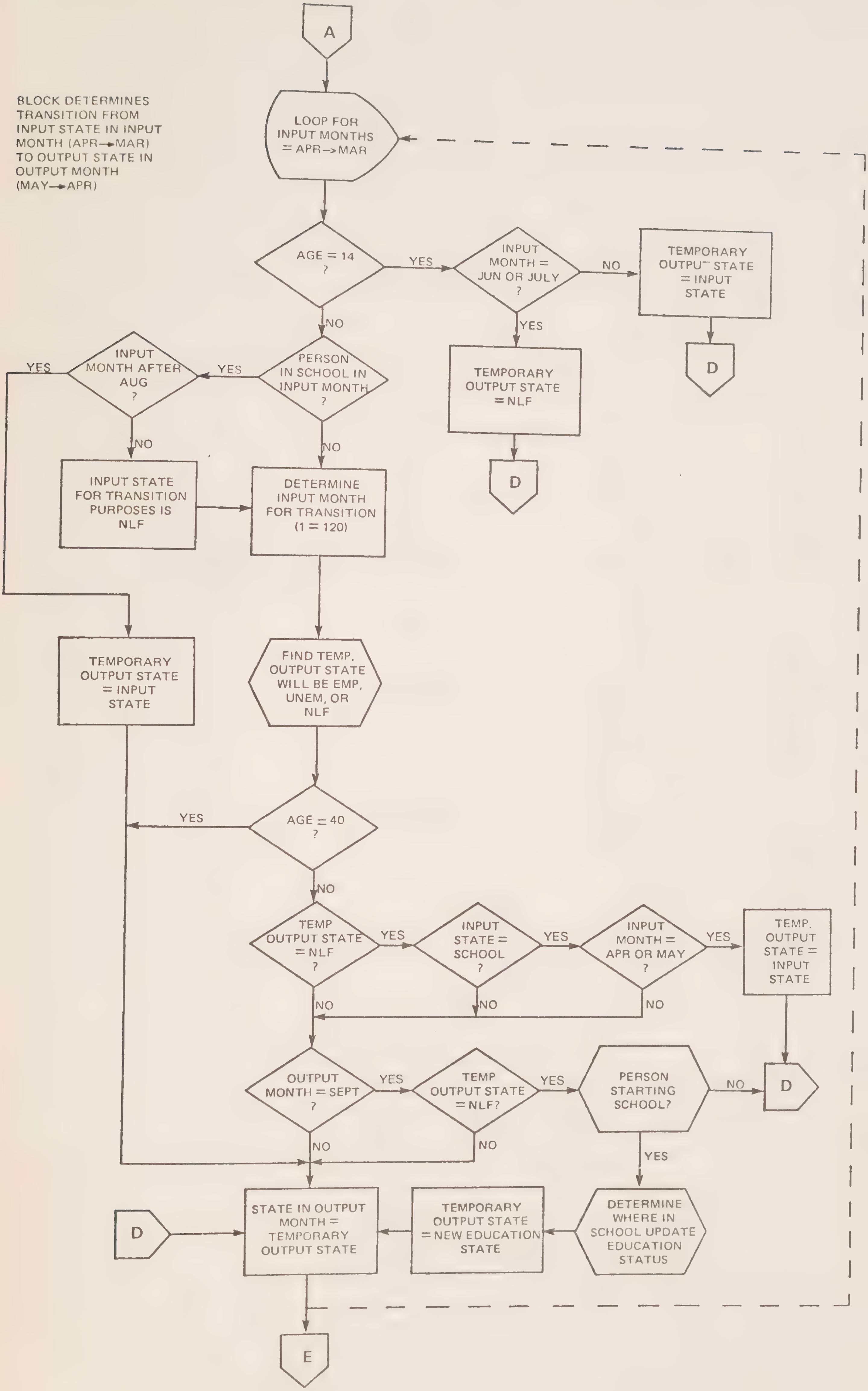
MACRO FLOW CHART OF THE
ACTIVITY STATUS BLOCK

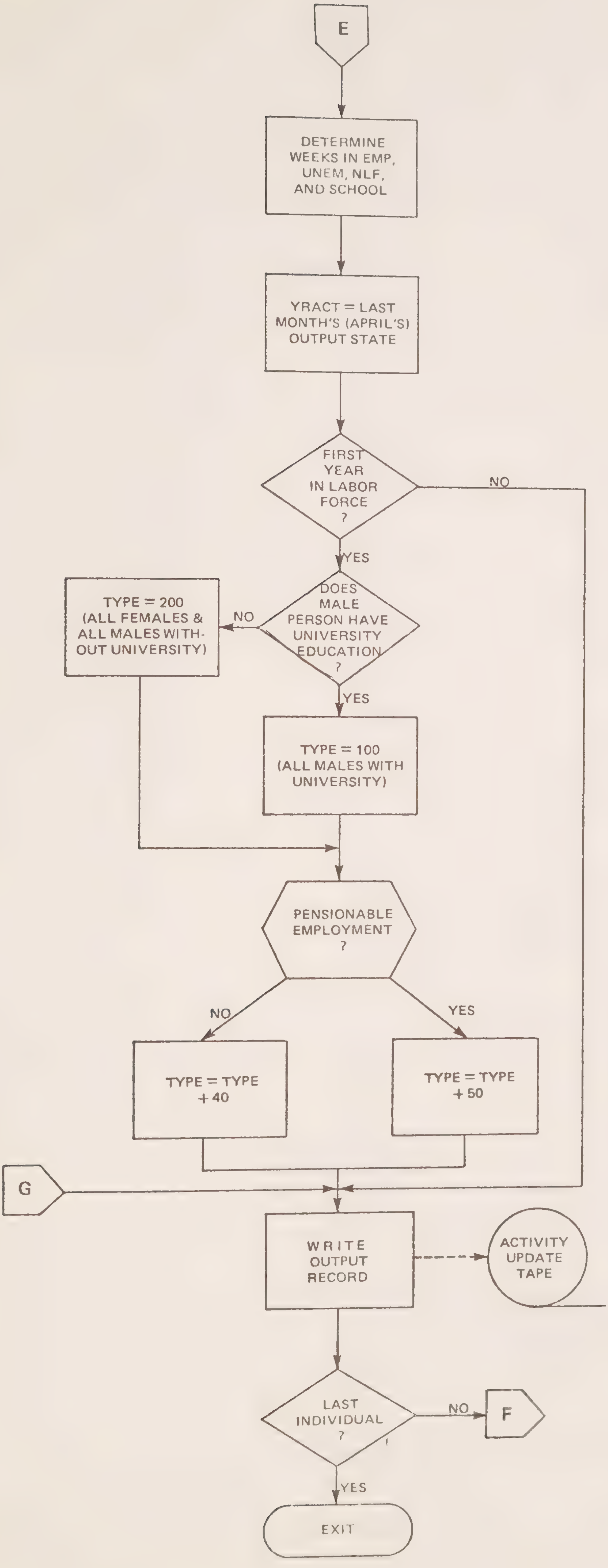
THE ACTIVITY BLOCK



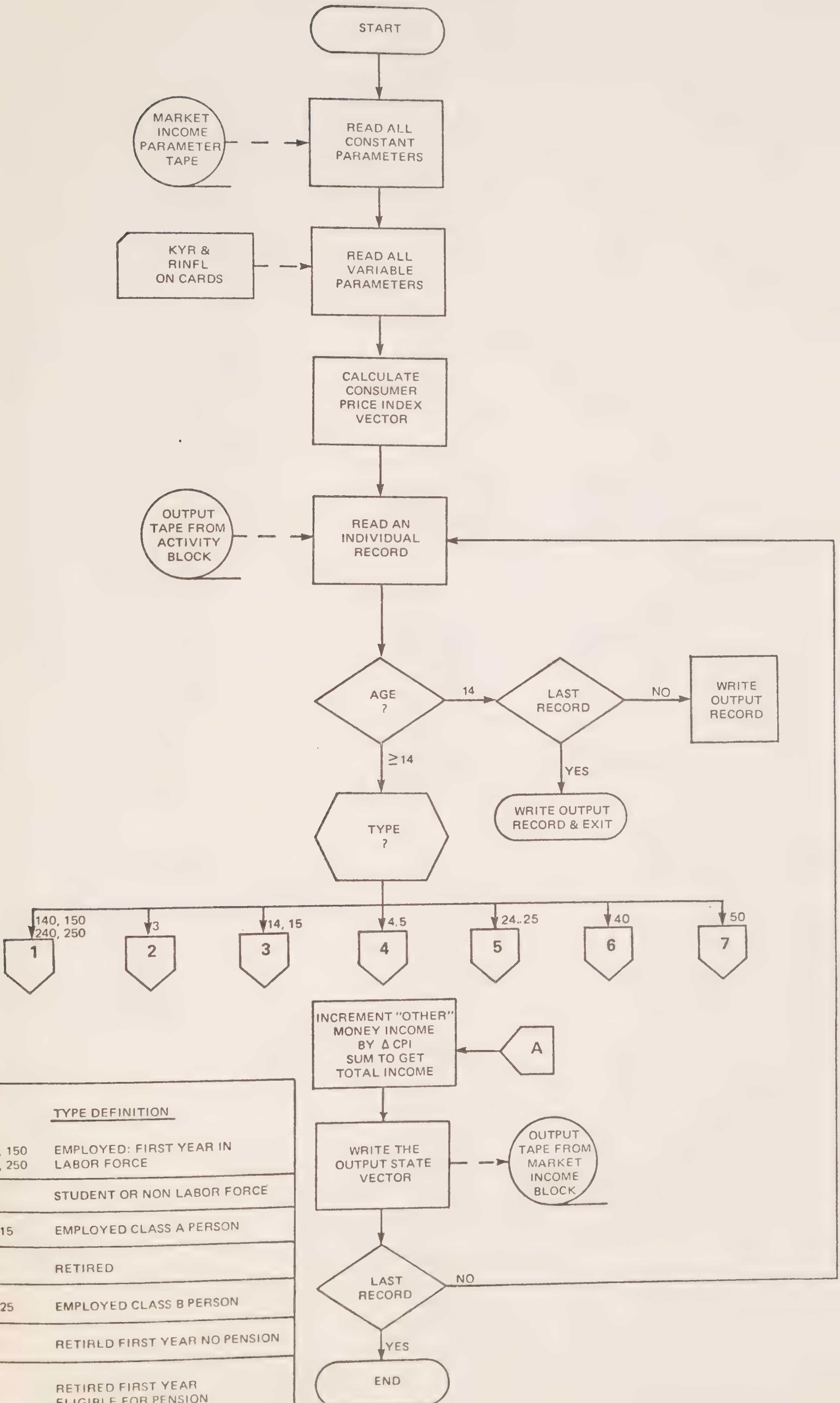


B
C
PERSON RETIRED ?
YES
WKEMP = 0
WKSCHL = 0
WKUNEM = 0
WKNLF = 52
YRACT = 22
G
PERSON IN NLF ?
YES
AGE 65 ?
NO
PERSON RETIRES NO PENSION
YES
A
NO
≥65
AGE ?
NO
PENSIONABLE EMP. ?
<65
YES
PERSON RETIRES TYPE = 40
C
AGE ?
≥65
PERSON RETIRES TYPE = 50
<65
C
AGE ?
≥60
WILL PERSON RETIRE?
YES
NO
CLASS OF PERSON ?
NEVER UNEMPLOYED
WKEMP = 52
WKUNEM = 0
WKNLF = 0
WKSCHL = 0
YRACT = 20
G
UNEMPLOYMENT POSSIBLE
LAST YEARS WKEMP=0 ?
YES
PERSON DIDN'T WORK LAST YEAR ∴ MUST ASSIGN INITIAL INCOME THIS YEAR → TYPE = TYPE *10
A
NO
CONVERT LAST YEAR'S WAGES TO WEEKLY RATE WAGES = WAGES + WKEMP
A


A
BLOCK DETERMINES TRANSITION FROM INPUT STATE IN INPUT MONTH (APR→MAR) TO OUTPUT STATE IN OUTPUT MONTH (MAY→APR)
LOOP FOR INPUT MONTHS = APR→MAR
AGE = 14 ?
YES
NO
INPUT MONTH = JUN OR JULY ?
TEMPORARY OUTPUT STATE = INPUT STATE
D
TEMPORARY OUTPUT STATE = NLF
PERSON IN SCHOOL IN INPUT MONTH ?
INPUT MONTH AFTER AUG ?
INPUT STATE FOR TRANSITION PURPOSES IS NLF
DETERMINE INPUT MONTH FOR TRANSITION (1 = 120)
TEMPORARY OUTPUT STATE = INPUT STATE
FIND TEMP. OUTPUT STATE WILL BE EMP, UNEM, OR NLF
AGE = 40 ?
TEMP OUTPUT STATE = NLF ?
INPUT STATE = SCHOOL ?
INPUT MONTH = APR OR MAY ?
TEMP. OUTPUT STATE = INPUT STATE
OUTPUT MONTH = SEPT ?
TEMP OUTPUT STATE = NLF?
PERSON STARTING SCHOOL?
DETERMINE WHERE IN SCHOOL UPDATE EDUCATION STATUS
TEMPORARY OUTPUT STATE = NEW EDUCATION STATE
STATE IN OUTPUT MONTH = TEMPORARY OUTPUT STATE
E

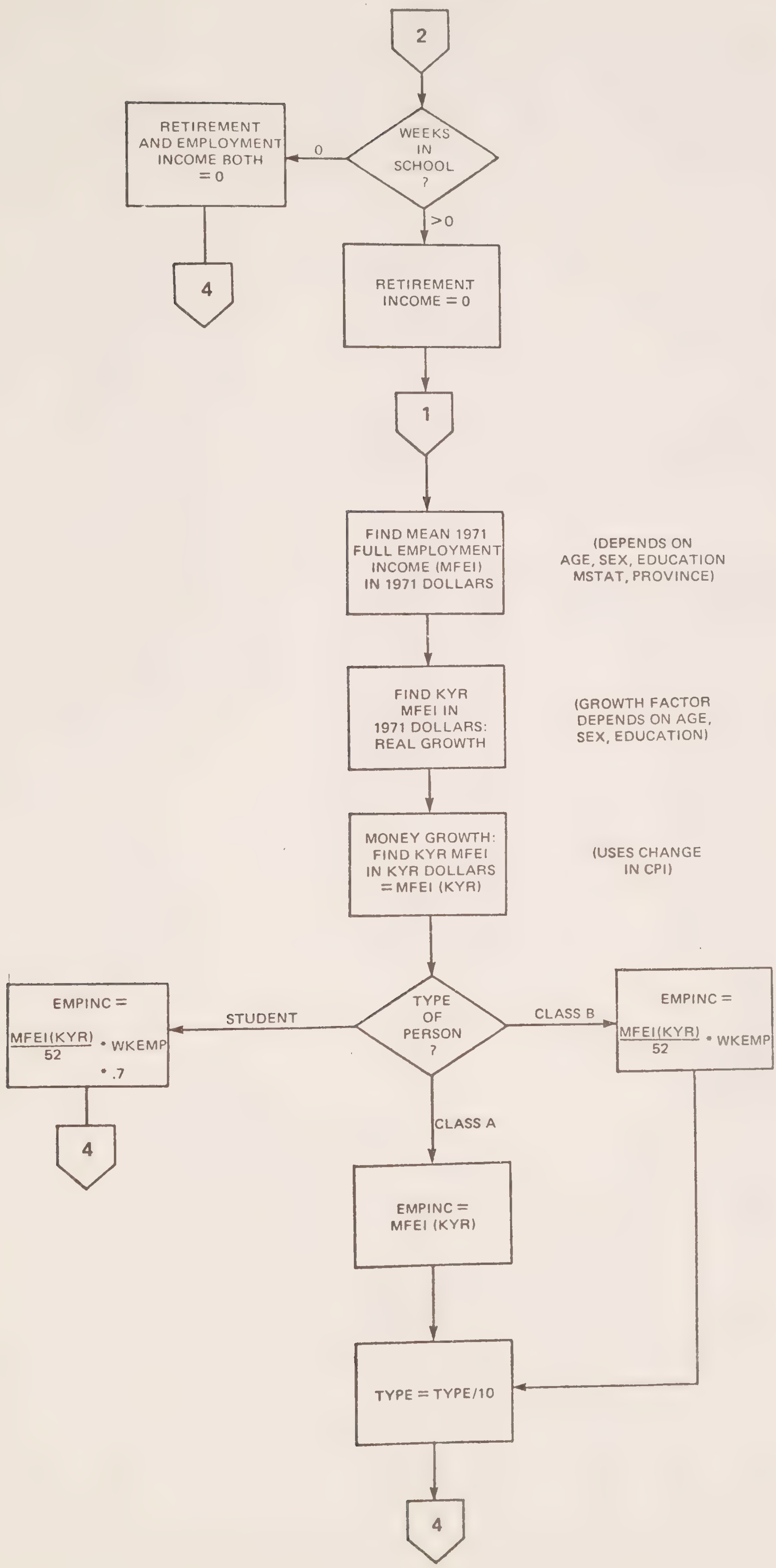

E
DETERMINE WEEKS IN EMP, UNEM, NLF, AND SCHOOL
YRACT = LAST MONTH'S (APRIL'S) OUTPUT STATE
FIRST YEAR IN LABOR FORCE ?
NO
YES
DOES MALE PERSON HAVE UNIVERSITY EDUCATION ?
NO
TYPE = 200 (ALL FEMALES & ALL MALES WITH-OUT UNIVERSITY)
YES
TYPE = 100 (ALL MALES WITH UNIVERSITY)
PENSIONABLE EMPLOYMENT ?
NO
YES
TYPE = TYPE + 40
TYPE = TYPE + 50
G
WRITE OUTPUT RECORD
ACTIVITY UPDATE TAPE
LAST INDIVIDUAL ?
NO
F
YES
EXIT

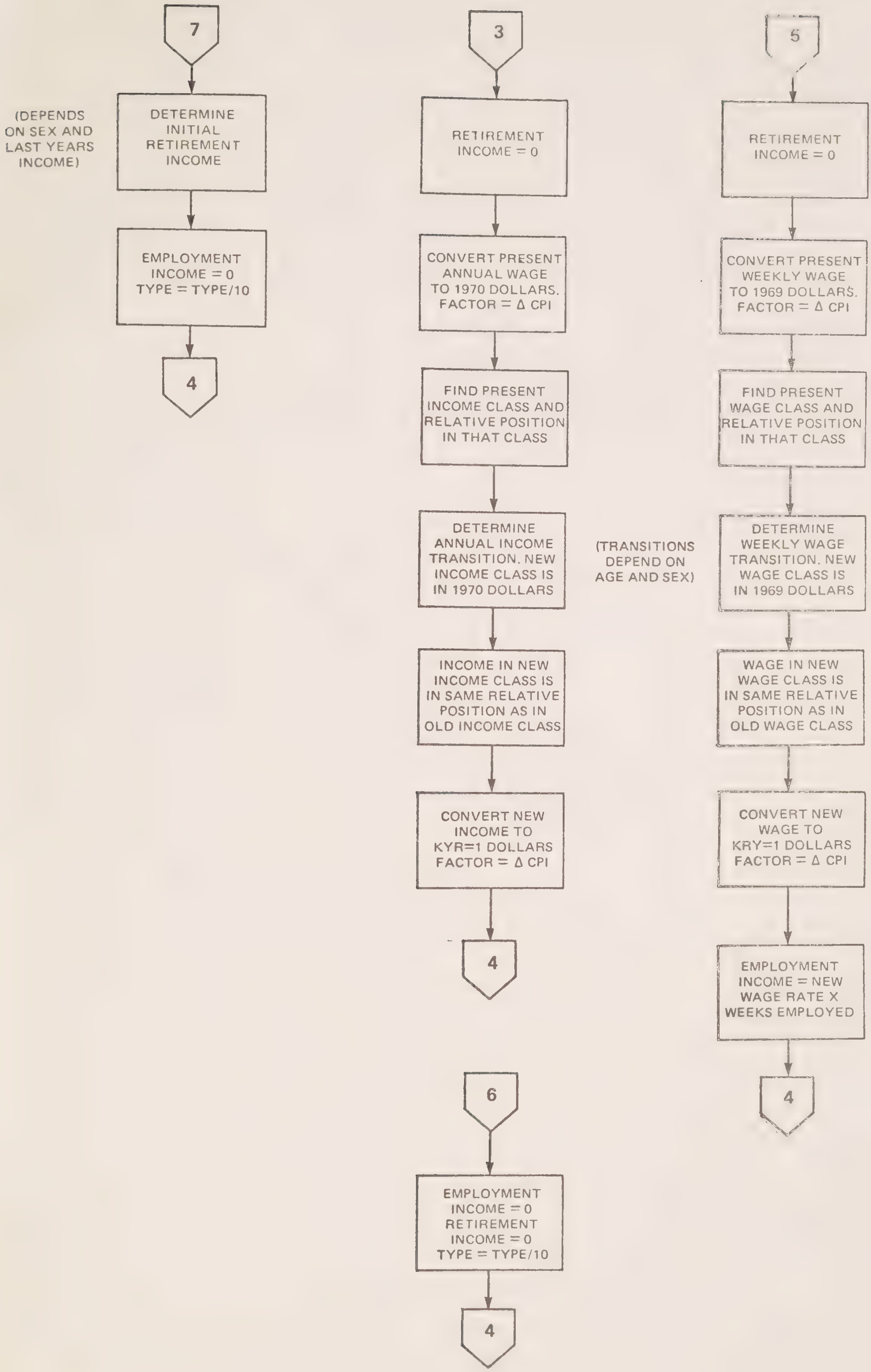
THE MARKET INCOME BLOCK



	TYPE DEFINITION
140, 150 240, 250	EMPLOYED: FIRST YEAR IN LABOR FORCE
3	STUDENT OR NON LABOR FORCE
14, 15	EMPLOYED CLASS A PERSON
4, 5	RETIRED
24, 25	EMPLOYED CLASS B PERSON
40	RETIRED FIRST YEAR NO PENSION
50	RETIRED FIRST YEAR ELIGIBLE FOR PENSION

INITIAL AND STUDENT INCOMES




7
(DEPENDS ON SEX AND LAST YEARS INCOME)
DETERMINE INITIAL RETIREMENT INCOME
EMPLOYMENT INCOME = 0 TYPE = TYPE/10
4
3
RETIREMENT INCOME = 0
CONVERT PRESENT ANNUAL WAGE TO 1970 DOLLARS. FACTOR = Δ CPI
FIND PRESENT INCOME CLASS AND RELATIVE POSITION IN THAT CLASS
DETERMINE ANNUAL INCOME TRANSITION. NEW INCOME CLASS IS IN 1970 DOLLARS
INCOME IN NEW INCOME CLASS IS IN SAME RELATIVE POSITION AS IN OLD INCOME CLASS
CONVERT NEW INCOME TO KYR=1 DOLLARS FACTOR = Δ CPI
4
6
EMPLOYMENT INCOME = 0 RETIREMENT INCOME = 0 TYPE = TYPE/10
4
5
RETIREMENT INCOME = 0
CONVERT PRESENT WEEKLY WAGE TO 1969 DOLLARS. FACTOR = Δ CPI
FIND PRESENT WAGE CLASS AND RELATIVE POSITION IN THAT CLASS
(TRANSITIONS DEPEND ON AGE AND SEX)
DETERMINE WEEKLY WAGE TRANSITION. NEW WAGE CLASS IS IN 1969 DOLLARS
WAGE IN NEW WAGE CLASS IS IN SAME RELATIVE POSITION AS IN OLD WAGE CLASS
CONVERT NEW WAGE TO KRY=1 DOLLARS FACTOR = Δ CPI
EMPLOYMENT INCOME = NEW WAGE RATE X WEEKS EMPLOYED
4

PROPERTY INCOMES